

**Outcome of primary health care rehabilitation of  
older disabled people in two different settings –  
an open, prospective, comparative observational study**

**Inger Johansen**



**Department of General Practice  
Institute of Health and Society  
Faculty of Medicine  
University of Oslo**

**Oslo 2013**

© Inger Johansen, 2013

*Series of dissertations submitted to the  
Faculty of Medicine, University of Oslo  
No. 1549*

ISBN 978-82-8264-523-2

All rights reserved. No part of this publication may be  
reproduced or transmitted, in any form or by any means, without permission.

Cover: Inger Sandved Anfinsen.  
Printed in Norway: AIT Oslo AS.

Produced in co-operation with Akademika publishing.  
The thesis is produced by Akademika publishing merely in connection with the  
thesis defence. Kindly direct all inquiries regarding the thesis to the copyright  
holder or the unit which grants the doctorate.



## Innholdsfortegnelse

|  |    |
|--|----|
| Preface, acknowledgements and funding .....  | 5  |
| Preface .....  | 5  |
| Acknowledgements .....   | 5  |
| Funding .....  | 7  |
| Summary in Norwegian (Norsk sammendrag) .....  | 8  |
| Bakgrunn .....   | 8  |
| Materiale og Metode .....  | 8  |
| Resultater .....   | 10 |
| Konklusjoner .....   | 11 |
| List of study papers .....   | 12 |
| List of abbreviations .....  | 13 |
| Section I. Background and important definitions.....   | 14 |
| Background for the study .....   | 14 |
| Aging of populations.....  | 14 |
| Disability of older people .....   | 14 |
| Short hospital stays and post-acute rehabilitation needs.....  | 15 |
| Pressure on health economy.....  | 15 |
| Short introduction to the study.....   | 15 |
| Important definitions .....  | 17 |
| The World Health Organization (WHO) International Classification of Functioning, Disability and Health, ICF[15]..... | 17 |
| Rehabilitation .....   | 18 |
| Rehabilitation potential.....  | 18 |
| Rehabilitation cycle and key features of successful rehabilitation .....   | 19 |
| Section II. Rehabilitation models for older disabled people, a literature review .....                               | 20 |
| Introductory remarks .....   | 20 |
| Rehabilitation models for older disabled people.....   | 21 |
| Home based programs .....  | 21 |
| Intermediate care .....  | 24 |
| Advanced practice nurse-centered discharge planning and home care intervention.....                                  | 27 |
| Geriatric Day Hospital, GDH .....  | 28 |
| Concluding remarks of the literature review .....  | 28 |
| Section III. Presentation of own research project.....   | 30 |

|   |    |
|---|----|
| The interventions .....   | 30 |
| Reasons for choosing the rehabilitation models in the present study .....                 | 30 |
| Primary Care Dedicated Inpatient Rehabilitation, PCDIR, Model 1 .....                     | 31 |
| Primary Care Nursing Home Rehabilitation, PCNHR, Model 2.....                             | 33 |
| Key variables.....  | 35 |
| Sunnaas ADL Index, SI.....  | 35 |
| Umeaa Life Satisfaction Checklist, LSC .....  | 36 |
| Mini Mental Status Evaluation, MMSE.....  | 36 |
| Symptom Check List-10, SCL-10 .....   | 37 |
| Other key variables.....  | 37 |
| A theoretical model for the association between dependent and independent variables ..... | 38 |
| The research questions .....  | 39 |
| Material and methods.....   | 41 |
| The study design.....   | 41 |
| The statistics .....  | 42 |
| The study participants and recruitment procedures .....                                   | 43 |
| Inclusion and exclusion criteria .....  | 46 |
| Reliability and validity of the data.....   | 46 |
| Synopsis of the study papers.....   | 49 |
| Synopsis of study paper I.....  | 49 |
| Synopsis of study paper II.....   | 50 |
| Synopsis of study paper III.....  | 51 |
| General Discussion .....  | 54 |
| Improvement in Activities of Daily Living, ADL.....                                       | 54 |
| Life satisfaction.....  | 57 |
| Rehabilitation length of stay, LOS .....  | 58 |
| Level of care .....   | 58 |
| Institutionalization .....  | 59 |
| Mortality.....  | 60 |
| Predictors of the outcomes .....  | 61 |
| Cost calculations.....  | 61 |
| Overall evaluation of PCDIR versus PCNHR.....   | 64 |
| Conclusions.....  | 68 |
| Answers to the research questions .....   | 68 |

|                                      |    |
|--------------------------------------|----|
| Implementation considerations .....  | 69 |
| Future research .....                | 69 |
| Section IV. List of references ..... | 71 |

## **Preface, acknowledgements and funding**

### **Preface**

I was already an experienced general practitioner back in the nineties when I more and more often noticed that rehabilitation of older people in the primary health care was arbitrary and without clear aims and plans. In 1998 I joined a multi-disciplinary project group which was planning a primary health care rehabilitation centre in the municipality of Larvik, Norway, where I lived and worked. The centre opened in 2004, and I was employed in a half-time job in charge of medical affairs. The objective of this centre was to offer primary health care rehabilitation to people aged 18 years and over with physical and minor cognitive disabilities. The first year's statistics showed that the mean age of the patients was 78 years. Most of the patients were able to return to their own homes after the rehabilitation. However, we did not know if and for how long time the patients maintained their functional gain after discharge. I wanted to learn the real outcome of this kind of rehabilitation of older people.

Since 2001 I was a teacher in general practice for medical students from the University of Oslo. This task brought me in contact with the researchers at the Department of General Practice. They encouraged me to try and do research studies in my everyday general practice. I was tumbling with the questions about rehabilitation of older people, and the available research literature did not give me good answers, so I decided to start my own research journey.

### **Acknowledgements**

I want to express my sincere gratitude to my main supervisor, professor Mette Brekke, for her continuous support, availability and wise comments through all these years. My gratitude also goes to the supervisors professor Morten Lindbaek and professor Johan K. Stanghelle. Their encouragements and in-depth knowledge has been of great importance for my work. Sunnaas

Rehabilitation Hospital and professor Stanghelle has been the main supervisor within the choice of rehabilitation indicators in this thesis.

I am also very grateful for having been part of the including and inspiring collegium at the General Practice Research Unit, chaired by professor Jorund Straand, and for the opportunity to attend the regular research meetings, skillfully moderated by scientific officer Atle Klovning.

My gratefulness also goes to the municipality of Larvik, in the county of Vestfold, Norway, and the health administrator Carl Erik Mathiesen, for the permission to conduct the study. The encouraging leader of the rehabilitation unit in Larvik, Jan Kulland, was indeed an important facilitator for the work. My thanks also go to the skilled personnel, who contributed substantially to the data collection and to my very experienced colleague Jon E. Johnson who took care of the medical tasks of the unit while I was on leave working with this project. I am also very grateful for the positive attitude and voluntary efforts of the health personnel in the comparison districts, the municipalities Andebu, Hof, Holmestrand, Lardal, Re and Stokke, in the county of Vestfold, Norway. The General Hospital of Vestfold, also welcomed the study and deserves thanks for facilitating the data collection.

I am also very grateful to my colleague Marie C. Stjärne, for her enduring work through these years in my general practice in a part time post as a deputy.

I owe personal thanks to my friend Pernille Holmene, who patiently listened and encouraged me during all our long walking tours. My greatest thanks goes to my husband Truls Erik, who has been my most critical teacher, carefully reading my papers, and repeatedly asking what I really wanted to tell. Finally, I want to thank our daughters Marie, Astrid, Ingrid and Liv and our sons in law for their humor and faithfulness. And not to forget my proudest acknowledgement: Through these six years of work with my PhD we got seven wonderful grand-children. They always remind me of what life is really about.



**Funding**

This study was funded by a six months scholarship from The Norwegian Association of General Practice and a five years half-time scholarship from The Norwegian General Practice Research Foundation. The data collection into the comparison group was funded by The Norwegian Medical Association's Foundation for quality improvement and patient safety.

## Summary in Norwegian (Norsk sammendrag)

### Bakgrunn

Befolkningene eldes i alle utviklede land. Stadig flere eldre utskrives fra sykehus med, eller bor hjemme med funksjonssvikt og behov for hjelp. Helseøkonomiene er presset, og stadig mer ansvar overføres til primærhelsetjenesten. Vi vet lite om effektene av rehabilitering av eldre med funksjonssvikt innen primærhelsetjenesten.

Formålet med denne studien var

- å sammenlikne effekten av tverrfaglig, døgnbasert rehabilitering av eldre i primærhelsetjenesten i strukturert og intensiv rehabilitering i egen enhet, versus standard rehabilitering i korttidsplasser i sykehjem og
- å studere eventuelle prediktorer for effektmålene
- å sammenlikne pasientenes funksjon, boforhold, antall dager i korttidsopphold i sykehjem og mortalitet inntil 18 måneder etter rehabilitering.
- å analysere kostnadene i de to modellene iløpet av oppfølgingstiden for rehabiliteringen, hjemmetjenestene og institusjonsoppholdene.

### Materiale og Metode

Studien var en åpen, prospektiv sammenliknende observasjonsstudie med oppfølging etter tre og 18 måneder. Settingen var tverrfaglig døgnbasert rehabilitering av eldre i primærhelsetjenesten i to ulike modeller. Den ene, intervensjonsmodellen, var en kommunal rehabiliteringsenhet med eget personale, som bare drev med rehabilitering (Primary Care Dedicated Inpatient Rehabilitation=PCDIR), der 202 pasienter ble inkludert. Den andre, standardmodellen, var rehabiliteringsplasser på korttidsavdelinger i sykehjem (Primary Care Nursing Home Rehabilitation=PCNHR) der 100 pasienter ble inkludert. Slike avdelinger har plasser både til rehabilitering, korttids pleie og avlastning. Rehabiliteringen i PCDIR ble i stor grad praktisert ifølge WHO's International Classification of Functioning, Disability and Health, ICF, og ICF's Rehabilitation

Cycle. Det innebærer en multidimensjonal vurdering av pasienten, klare mål og tiltak skreddersydd den enkelte pasient, regelmessig tverrfaglig evaluering av behandlingen i samarbeid med pasienten og i nær dialog med øvrig helsepersonell som er involvert i omsorgen for pasienten. PCNHR inneholdt også elementene i ICF's Rehabilitation Cycle, men mindre konsekvent. Inklusjonskriteriene i begge grupper var pasienter  $\geq 65$  år, som ble vurdert å ha rehabiliteringspotensial, og som var henvist til rehabilitering i primærhelsetjenesten, enten direkte fra sykehus eller fra hjemmet.

Diagnosegruppene var hjerneslag, ortopediske problemstillinger, kronisk langsomt progredierende sykdommer og funksjonssvikt grunnet lange sykehusopphold eller aldring. Eksklusjonsdiagnoser var raskt progredierende sykdom, alvorlig KOLS med taledyspne, ustabil angina pectoris, uavklart hjertearytmi, aktiv psykose og dyp depresjon. Det primære effektmålet var Activities of Daily Living=ADL, registrert ved Sunnaas ADL Index (SI), ved starten av og ved avsluttet rehabilitering, og tre og 18 måneder etter avsluttet rehabilitering. Sekundært effektmål var livstilfredshet, registrert med Umeå Life Satisfaction Checklist (LSC) ved avsluttet rehabilitering og tre måneder deretter.

Variablene for å studere påvirkning av effektmålene var kognitiv status, målt ved Mini Mental Status Evaluation (MMSE) og psykisk status, målt ved Symptom Checklist 10 (SCL10). Det ble også registrert pasientkarakteristika og varighet av rehabiliteringen. Hjelp i hjemmet fra omsorgstjenesten og pårørende ble registrert ved avsluttet rehabilitering og tre måneder etter. Foruten å skåre SI i oppfølgingsstudien 18 måneder etter rehabiliteringen, ble det registrert antall dager pasienten hadde vært i sykehus og i korttidsopphold på sykehjem, og registrert boforhold og død.

Kostnadsanalysene gjaldt kostnader til rehabiliteringen, hjemmetjenestene, opphold i sykehus og korttids sykehjemsopphold.

Statistiske metoder var: T-Tester, Pearson's  $\chi^2$ , ANCOVA, Univariat- og Multippel lineær regresjonsanalyse.

Studien ble godkjent av Regional Etisk Komite Sør (REK Sør) og av Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Studien er registrert i Clinicaltrials.gov ID NCT01457300.

## Resultater

Det var ingen signifikante forskjeller mellom de to gruppene innen pasientkarakteristika (gjennomsnittsalder 80 år), diagnosegrupper og kognitiv og psykisk status. 70% av pasientene i begge grupper var kvinner. De var i gjennomsnitt to år eldre enn mennene. Omkring 70% av kvinnene og 35% av mennene var aleneboende. Den hyppigste diagnosen blant kvinnene var lårhalsbrudd og blant mennene hjerneslag.

Økningen i SI-skår: PCDIR-pasientene økte SI-skår 4.2 poeng, CI(3.5-4.8) iløpet av 3.1 ukers rehabilitering mens PCNHR-pasientene økte 2.7 poeng CI(1.9-3.6) iløpet av 5.5 uker. Forskjellen i SI-skår mellom modellene var 1.9 poeng (CI (0.99-2.81),  $p < 0.001$ , ANCOVA), etter korreksjon for en ved baseline forskjell i SI-skår mellom modellene, som var ikke statistisk signifikant.

18 måneder etter rehabiliteringen var samlet SI-skår for begge gruppene 0.9 poeng (CI (0.3-1.5)) lavere enn ved avsluttet rehabilitering, en statistisk, men ikke klinisk signifikant reduksjon.

Forskjellen i SI-skår mellom gruppene vedvarte imidlertid og var 2.2 poeng (CI (.8-3.7)  $p = 0.003$ , Multippel lineær regresjonsanalyse), korrigert for kjønn, alder, baseline SI-skår og MMSE-skår.

Livstilfredshet: 80% av pasientene i begge grupper var fornøyd med livet og evnen til å klare seg selv (LSC-skår  $> 4$ ).

Hjelpebehov i hjemmet: Færre PCDIR-pasienter mottok hjemmetjenester  $> 3$  timer/uke (OR=0.6 CI(0.4-0.8),  $p = 0.002$ ). I PCDIR-gruppen hjalp de pårørende pasientene i like stor grad som hjemmetjenesten, mens pårørende bidro signifikant mindre i PCNHR-gruppen.

Det var en meget sterk negativ korrelasjon mellom SI-skår og graden av hjemmetjenester i begge grupper.

Prediktoranalyser: MMSE-skår var en gjennomgående positiv prediktor for økningen i SI-skår og en negativ prediktor for antall timer hjemmetjenester og antall dager i korttidsopphold i sykehjem i begge grupper.

Korttidsopphold i sykehjem, institusjonalisering og død inntil 18 måneders oppfølging: 40% av pasientene i begge grupper hadde korttidsopphold på sykehjem, men PCNHR-pasientene hadde signifikant flere dager. Andelen pasienter som var bosatt i omsorgsleilighet eller sykehjem ble doblet i PCNHR mens det ikke var noen økning i PCDIR. Blant PCDIR-pasientene >80 år bodde 9.8% i sykehjem, hvilket var 30% lavere enn i befolkningen generelt i 2007 (SSB). Mortaliteten i totalmaterialet var 9.8%, og det var ingen statistisk signifikant forskjell mellom gruppene.

Kostnadsanalyser: Kostnadene for rehabiliteringen og hjemmetjenestene var statistisk signifikant høyere i PCNHR enn i PCDIR, og totalkostnadene var 1.6 ganger høyere i PCNHR.

## Konklusjoner

Eldre pasienter med funksjonssvikt, som mottok tverrfaglig, strukturert og intensiv døgnbasert rehabilitering i primærhelsetjenesten i egen kommunal enhet (PCDIR), forbedret evnen til å mestre dagliglivets aktiviteter til nesten det dobbelte i løpet av ned mot halve rehabiliteringstiden, sammenliknet med standard rehabilitering i korttidsplasser på sykehjem (PCNHR). Forskjellen i effekt mellom modellene var fortsatt tilstede 18 måneder etter rehabiliteringen. Pasientene i PCDIR trengte mindre hjemmetjenester. De tilbragte færre dager i korttidsplasser på sykehjem frem til 18 måneder etter rehabiliteringen, og andelen pasienter bosatt i omsorgsleilighet eller sykehjem var stabil, mens den ble doblet i PCNHR. Alle omtalte effekter var statistisk signifikante. Rehabiliteringen i PCDIR var både mer effektiv og kostet mindre enn rehabiliteringen i PCNHR.

Eldres ønske om å bo hjemme med størst mulig grad av selvstendighet og samfunnets ønske om å redusere helsekostnader og behovet for sykehjemsplasser er sterke grunner for å ta PCDIR modellen i bruk i hele landet.

## List of study papers

- a. Johansen I, Lindbaek M, Stanghelle JK, Brekke M. **Effective rehabilitation of older people in a district rehabilitation center.** *J Rehabil Med* 2011 Apr; **43**(5): 461-4.
- b. Johansen I, Lindbaek M, Stanghelle JK, Brekke M. **Structured community-based inpatient rehabilitation of older patients is better than standard primary health care rehabilitation – an open comparative study.** *Disabil Rehabil* 2012; 34(24):2039-2046.
- c. Johansen I, Lindbaek M, Stanghelle JK, Brekke M. **Independence, institutionalization, death and treatment costs 18 months after rehabilitation of older people in two different primary health care settings.** *BMC Health Services Research*.2012, 12:400. DOI: 10.1186/1472-6963-12-400.

## List of abbreviations

|        |   |
|--------|---|
| ADL    | Activities of daily living  |
| CH     | Community hospital  |
| DHR    | Day hospital rehabilitation   |
| ED     | Early discharge   |
| EDRS   | Early discharge rehabilitation service                              |
| ESD    | Early supported discharge   |
| ESUS   | Extended stroke unit service  |
| GDH    | Geriatric day hospital  |
| HBR    | Home based rehabilitation   |
| ICF    | WHO International classification of function, disability and health |
| LOS    | Length of stay  |
| LSC    | Umeaa Life Satisfaction Checklist                                   |
| MMSE   | Mini Mental Status Evaluation                                       |
| NLU    | Nursing led inpatient units   |
| PCDIR  | Primary care dedicated inpatient rehabilitation                     |
| PCNHR  | Primary care nursing home rehabilitation                            |
| SCL-10 | Symptom Checklist-10, SCL-10  |
| SI     | Sunnaas ADL Index   |
| WHO    | World Health Organization   |

## **Section I. Background and important definitions**

### **Background for the study**

#### **Aging of populations**

The number and relative proportion of people aged >65 years will increase in all developed countries during the next decades. Increasing life expectancy has been a trend since early in the 19<sup>th</sup> century, and it still keeps rising [1]. In Norway 600.000 persons were older than 65 years in 2006. This number is expected to be twice as high in 2050, which means an increase from 14% of the population to between 19 and 27%. The population aged >90 years (27.000 in 2006) will probably increase by a factor of three to six [2]. In Southern and Eastern Europe probably 40% of the populations will be aged >65 years by 2050 [3].

#### **Disability of older people**

Studies indicate that the ageing populations in developed countries have become less disabled over the last 20-30 years [4,5]. This is also supported by cost analyses [6]. The need for assistance in personal care associated with frailty has been reduced. Scrutiny of available data however indicates that the reduction in disability may mainly be due to environmental facilitators. Independence with assistive devices have increased. Institutional residence has been stable[7]. Although disability measures have shown improvement, there is a simultaneous increase in chronic disease and functional impairments, which require care resources[8]. The OECD Health Working Paper No 26 2007 reads: "Trends in severe disability among older people: Assessing the evidence in 12 OECD countries and the future implication: Even though disability prevalence rates have declined to some extent in some countries, the ageing of the population and the greater longevity of individuals can be expected to lead to increasing numbers of people at older ages with a severe disability and in need of long-term care. The results of the projection exercise to 2030 for all countries, regardless of different



trends in disability prevalence, confirm this important finding” [9]. In the UK the number of persons with a functional decline and a high level of need of care are estimated to increase by more than 50% by 2025, and most of them will be older people [10]. It is generally agreed that frail older hip fracture patients should receive geriatric rehabilitation [11].

### **Short hospital stays and post-acute rehabilitation needs**

During the last decades hospital admissions have increased and the hospital length of stay has decreased. More old patients are discharged to the communities with disabilities and need for rehabilitation and care facilities. A recent report tells that 70% of acute hospital bed days were occupied by older people waiting for access to rehabilitation services, domiciliary support and residential care [12]. Up to one quarter of patients admitted acutely to an elderly care department may need post-acute intermediate care services [13]. It is therefore an urgent need for efficient and well designed rehabilitation and care facilities for older people in the communities.

### **Pressure on health economy**

To relieve the hospital bed crisis and the pressure on the health economies, a contemporary political strategy in many countries is to move the responsibility for health care from specialist based hospitals to general practitioner based services in the communities [14].

An increasing number of people also experience functional losses while ageing in their own homes. In order to continue to live in their homes and maintain the best possible independence and quality of life, these people also need effective rehabilitation.

### **Short introduction to the study**

Rehabilitation of older people is practiced at the specialist, intermediate and primary health care levels. Several rehabilitation models have been developed and are evaluated at each level. However,

rehabilitation of older patients in true primary health care settings is poorly described and evaluated. To meet the increasing number of disabled older people in a future health care scenario, we need to develop effective rehabilitation models based on primary health care resources.

The key questions asked in this study were: Is multi-disciplinary “Primary Care Dedicated Inpatient Rehabilitation”(PCDIR) of older people effective? If so, is PCDIR more effective compared to standard “Primary Care Nursing Home Rehabilitation”(PCNHR)? What are the long term outcomes and costs of PCDIR compared to PCNHR?

The study design was an open, prospective, comparative observational study.

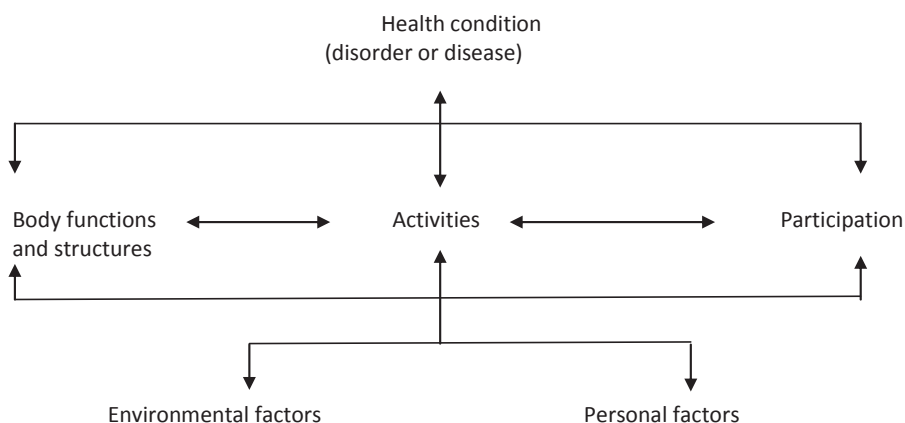
The study participants were old people  $\geq 65$  years admitted to either PCDIR or PCNHR rehabilitation, either post-acute from a district general hospital or directly from their own homes. The patients were living in and were recruited from two demographically and geographically similar districts in the county of Vestfold, Norway.

An overall aim of this study was to obtain more knowledge about the outcome of rehabilitation of older disabled people in the primary health care setting, and hopefully contribute to the development of a national rehabilitation strategy for older disabled people.

## Important definitions

### The World Health Organization (WHO) International Classification of Functioning, Disability and Health, ICF[15]

Disease is a matter of diagnoses and treatment, but also of the consequences for the individual patient. ICF is a dynamic model that systematize the complex interaction between a person's health condition, his personal resources and environmental factors[16]. It describes the complementary factors functioning and disability in a bio-psycho- social perspective. ICF is divided into six dimensions: Body functions and –structures, activities, participation, environmental and personal factors (Figure 1).



**Figure 1.** Interaction between the components of the International Classification of Functioning, Disability and Health (ICF) [17]

Each dimension is subdivided into several chapters. ICF provides a joint tool in the multi-disciplinary work of rehabilitation and is useful in the every-day practical rehabilitation work with both younger

and older disabled people [18-20]. It is also important for standardization in research and documentation.

## **Rehabilitation**

From a public health perspective rehabilitation can be understood as one of the four main health strategies: prevention, cure, rehabilitation and support [17]. According to ICF human functioning includes the components body functions and structures, activities and participation and is viewed in relation to the health condition and personal and environmental factors (Figure 1). Disability is complementary to functioning and includes impairments, limitations in activities and restrictions in participation[21]. The aim of rehabilitation is to maximize function and minimize disability resulting from an underlying impairment or disease [22]. The current definitions of rehabilitation include both biomedical and environmental aspects. A brief definition of rehabilitation is: A health strategy that aims to enable people with health conditions experiencing or likely to experience disability to achieve and maintain optimal functioning in interaction with the environment [10]. In the Norwegian White Paper No 21, “Responsibility and Empowerment” (“Ansvar og Meistring”) rehabilitation is described as: Time limited, planned, multi-disciplinary processes, with clear aims and means, to give necessary assistance to the patients’ own effort to achieve an optimal level of functioning, independence and social participation [23].

## **Rehabilitation potential**

Rehabilitation potential can be defined as the physical, cognitive and emotional possibilities of a disabled person to restore, keep or develop the best possible level of functioning and quality of life [12]. In rehabilitation medicine the variable of primary interest is the patient’s functional ability [24]. Assessment of the rehabilitation potential is done by a multi-disciplinary team and is always based on

a total evaluation of the functional possibilities and limitations according to each of the elements in ICF. In this work the ADL scores and assessments of the medical, cognitive and emotional status are essential. Other decisive factors for the rehabilitation potential are the patient's own wish and motivation to take part in a demanding rehabilitation process, as well as the ability of the environments to remove barriers and present facilitators. It is not possible to give exact cut-off scores of the ADL-, cognitive-, emotional- and the medical status indicating a rehabilitation potential. Patients with low scores in a single variable may still have a rehabilitation potential if she/he has higher scores or improve rapidly in another variable or if crucial environmental barriers can be removed. We believe that the multi-disciplinary team and the standardized assessment ensure objectivity in the evaluation of whether the patient has a rehabilitation potential or not. The score ranges indicating rehabilitation potential is further elaborated in the chapter "Key variables", page 35-37.

### **Rehabilitation cycle and key features of successful rehabilitation**

The interaction between the different dimensions of the ICF is also named the WHO framework rehabilitation cycle. It has been shown that rehabilitation programmes which adopted this ICF rehabilitation cycle as a working model were more successful compared to standard care [25]. Such programmes include a multi-dimensional assessment of the patient, a clear goal setting and interventions tailored to the individual patient, stringent assignment to therapies, regular evaluation of the interventions with the care team and the patient and a close dialogue with all health professionals involved in the care of the patient [14]. A multi-disciplinary and co-ordinated approach is essential for a successful rehabilitation of patients with stroke, rheumatoid arthritis, hip fractures and of geriatric patients in general [11] [26]. The rehabilitation is carried out by dedicated personnel, either on an inpatient basis, on an outpatient basis or in the patients own home. The rehabilitation environments are active and stimulating.

## **Section II. Rehabilitation models for older disabled people, a literature review**

### **Introductory remarks**

According to the literature rehabilitation of older disabled people is practiced differently, not only between different countries, but also within the same country. Various models for rehabilitation are described, evaluated and compared in many studies. A Cochrane review from 2003, which was updated in 2008, concludes that although there are a large number of publications there is not enough information to get sufficient evidence from comparison of different models [27]. According to the review authors there are three main reasons for insufficient evidence:

1. "The description and specification of the environment is often not clear".
2. "The components of the rehabilitation system within the given environments are not adequately specified".
3. "When the components are clearly specified, they demonstrate that the control and intervention sites are not comparable with respect to the methodological criteria specified by Cochrane EPOC group".

Most studies on rehabilitation of older disabled people are based on the specialist health care or a shared care between the primary and specialist care. We have not been able to identify any papers evaluating pure primary health care programs like PCDIR or PCNHR. However, the shared care models have most similarities to the models used in our study.

Several literature searches have been made at different time points during the project period. The PubMed and Cochrane databases were searched according to the PICO strategy for systematic searches. The first systematic search was done through PubMed in 2008, and the search words were

“Older people” AND “Rehabilitation” AND “Community” AND “Effect”, and the search was limited to the time period 1998-2008. This search gave 624 titles, of which 40 were of interest for the study in terms of rehabilitation models and outcome measures. In a not time limited search made in 2012 the search words were “Aged” OR “Aged, 80 and over” AND “Rehabilitation” AND “Independence” AND “Primary health care”. This search gave 169 titles, of which 23 were of interest for the study. A recent search in the Cochrane database for reviews and meta-analyses of “Rehabilitation” and “Older people”, gave 131 titles, of which 19 were of interest for the present study.

During the review process we were always looking for papers which evaluated different rehabilitation models for disabled older people. When relevant publications were found we also searched the “Relates citations” field, which regularly resulted in more papers of interest. We always read the reference lists carefully in publications considered to be of high relevance for the study. For the present review we selected publications which according to our opinion provided the best evidence and gave the most comprehensive description of the specific rehabilitation models.

We did not divide the literature search into the time periods before and after the start of the present study. No studies by other authors were published in our research field during the time period for our project.

## **Rehabilitation models for older disabled people**

### **Home based programs**

#### **Preventive home visiting programs**

Preventive home visiting programs are aimed at improving the health and independent functioning of older people living at home. They also intend to reduce the number of hospital and nursing home admissions and associated costs. So far, the effect of such programs have been inconclusive what

concerns mortality, functional status, quality of life, service use and costs. The selected papers are presented below.

Primary care programs targeting people with poor health aged 65 years or more were systematically reviewed by Bouman A et al in 2008 [28]. 844 abstracts were identified, 8 papers met the inclusion criteria and 7 were of sufficient methodological quality. Programs lasting for at least 12 months and consisting of at least four visits per year by experienced nurses or GP's, had no significant favorable effect on mortality, health status, service use and cost.

However, another systematic review and meta-analysis of randomized controlled trials by Huss A et al, showed that functional decline was reduced if the program included a clinical examination in the initial assessment [29]. This review also showed reduced mortality among younger patients, which has been confirmed in another review[30]. A review of restorative approaches towards home care for frail older people showed improved quality of life and functional status and reduced costs associated with a reduction in the ongoing use of home care services post-intervention[31]. However, questions remain about which components are most beneficial, which clients are likely to receive the greatest benefit, and the appropriate intensity and duration of such interventions.

In a Dutch RCT of 330 older people aged 70-84 the intervention was eight home visits, lasting 1 hour or more, with telephone follow-up, over an 18-month period, conducted by experienced home nurses under supervision by a public health nurse. The key elements of the systematic visits were assessment of health problems and risks, advice, and referral to professional and community services when needed. The outcomes were self-rated health, functional status, quality of life, and changes in self-reported problems. No differences were found between the intervention group and the standard care group in these and other outcome measures at the end of the intervention period of 18 months [32].



Danish municipalities are required by state law since 1998 to offer two annual home visits to all non-disabled citizens  $> \text{ or } = 75$  years. A randomized controlled study from 1999-2001 evaluated the effect of a 3-year educational intervention to the primary health care, including a shorter program to GPs. In the intervention group the preventive home visits were carried out in a standardized way, focusing on early signs of disability and on physical activity. The functional ability, mortality and rate of nursing home admission of older people at 75- and 80 years living at home was studied. Interestingly, the intervention was associated with better and sustained functional ability among the women at the end of intervention and at 18 months follow-up, while no effects were seen in men [33-35]. No differences were found in mortality or institutional residence rate between intervention and control municipalities at the end of intervention [36].

### **Home Based Rehabilitation, HBR**

The rationale for this program is that rehabilitation at home might facilitate functioning and participation since the rehabilitation takes place in familiar environments and the possible inactivating element of an institution is avoided. On the other hand, HBR may not be sufficiently multi-disciplinary and intensive for optimal rehabilitation. Furthermore, cramped homes and too many demands on the family may be barriers that have to be met seriously. The outcome from HBR studies diverge. Even if geriatricians are involved in the intervention, the outcomes are marginal. However, HBR seems to be beneficial for younger and more healthy patients with social support[37].

Post-hospital rehabilitation was compared in HBR versus in Day hospital rehabilitation, DHR, in a RCT [38]. From baseline to 3 months follow-up there were significant improvements in the functional outcomes for all participants ( $n=229$ ). Patients in DHR had twice as high risk of readmission compared to those in home rehabilitation both at 3 and 6 months follow-up. The authors conclude that DHR patients are more likely to be readmitted to hospital, possibly due to easier access to the medical staff responsible for admissions.

The same services were compared in another RCT [39]. The conclusion was that rehabilitation in patients' own homes confers no particular disadvantage for patients and carers. The cost of HBR was not significantly different from that of providing DHR. However, in this RCT selection bias could have disturbed the results, because a large proportion of potentially eligible subjects refused to participate, the required sample size was not reached, and there was a relatively large loss to follow-up.

A home-based control-oriented strategy intervention by physio and occupational therapists to people aged 70 years and older with difficulties performing activities of daily living, showed statistically significant reduced mortality up to 2 years follow-up. Older people with a moderate mortality risk got the highest intervention benefit in terms of reduced mortality compared to the no-treatment control group [40,41].

In the Netherlands a problem-based multi-disciplinary intervention program for elderly frail persons(The Dutch EASY care study)has been compared to usual care. The patients' GP referred old vulnerable people to the program, for problems with cognition, nutrition, behavior, mood or mobility. Geriatric nurses visited the patients at home up to six times within three months. They did assessment and management in cooperation with the GP's and geriatricians. At three months both functional ability and well-being improved significantly. At six months well-being still improved, but there was no longer significant effect on functional ability [42].

### **Intermediate care**

Intermediate care can be defined as: Short-term intervention to preserve the independence of people who might otherwise face unnecessarily prolonged hospital stays or inappropriate admission to hospital or residential care. The care is person-centered, focused on rehabilitation and delivered by a combination of professional groups [43].

Another definition is: A range of services designed to facilitate the transition from hospital to home, and from medical dependence to functional independence, where the objective of care is not primarily medical, the patient's discharge destination is anticipated and a clinical outcome of recovery or restoration of health is desired [44].

The aim of intermediate care has been two-fold: Firstly it intends to enhance quality of care received by patients while reducing or preventing an unnecessary acute hospital stay. Secondly, by removing these patients from acute care facilities, resources in those facilities can be used more appropriately. Patients inappropriately placed in acute hospital beds neither require nor benefit from the full range of disciplines and facilities of the acute ward [45].

### **Early discharge(ED) to hospital at home**

A systematic Cochrane review of this service was done by Shepperd S et al in 2009. The service has been met with great interest as a possible cheap alternative to inpatient care, but there is so far insufficient objective evidence for economic benefit or improved health outcomes [46]. There are however, strong indications that if the service is well organized with a well-staffed and coordinated multi-disciplinary team, some older people can be discharged home earlier and can achieve better functional levels and psychological well-being. Interestingly, the early supported discharge, ESD, from the stroke unit of stroke patients to their homes may reduce mortality and institutional care compared to stroke patients who receive prolonged hospital care.

Early discharge rehabilitation service, EDRS, consists of an organized and person-centered package of rehabilitation and care, delivered by a well-staffed and coordinated multi-disciplinary team [47]. It is offered to older people discharged early after an acute hospital stay and who are able to receive this service at home. This model seems to help some older people to be discharged home earlier and to achieve better functional levels and psychological well-being both at short and long term(1 year), compared to usual post-hospital community care. There were no differences in survival or residential status. The intervention is functional rehabilitation training, teaching of skills, information and

advice, overcoming emotional barriers to task performance, provision of aids and of personal and domestic care.

Early supported discharge (ESD) to home of patients from a stroke unit results in lower mortality and serious disability and fewer days in hospital. It also seems to reduce institutional care and to improve patients' chances of living at home five years after stroke compared to traditional stroke care. There is also a trend toward improved functional outcome 5 years after the stroke in the ESD stroke group [48-50].

### **Community hospital, CH**

CH has been part of the health care system in UK for a long period of time and is an intermediate care service. Finland, The Netherlands and Norway also have experience with this service. CH are small hospitals(20-30 beds) with few on-site diagnostic services. They offer multi-disciplinary care and are primarily focused on the post-acute needs and rehabilitation of older patients. CHs are considered appropriate for patients that need and will benefit from a lower intensity of care than what is given in general hospitals[51].

A multicenter, randomized, controlled trial showed that loss of independence at six months was significantly less likely after rehabilitation of older people in CH compared to general hospitals [52,53].

Post-acute intermediate care at a CH was compared to further general hospital care in a Norwegian RCT [54]. This study found significantly decreased number of re-admissions for the same disease to general hospitals, and more patients were independent of community care after 26 weeks of follow up, without any increase in mortality and number of days in institutions. At 12 months follow-up the mortality was significantly lower in the CH group. However, there were now no differences in level of independence, at-home care or institutionalization [54,55].

### **Nurse-led inpatient units, NLU**

NLU is one of a range of intermediate care services that have been established in order to manage more successfully the transition between hospital and home for patients with extended recovery times. NLU's are led by nurses, and their aim is to enhance the quality and quantity of nursing care for patients preparing for discharge. Some evidence has been found that the NLU patients are better prepared for discharge to home. However, no reduction in institutional care has been found, and the possibility of an early increased mortality has to be watched carefully [45,56].

Controlled trials and interrupted time series design trials that compared the NLU to usual inpatient care managed by doctors were systematically reviewed by Griffiths PD et al in a Cochrane meta-analysis in 2007[45]. Studies based on patients in need of care following an acute hospital admission for a physical health condition were included. They were aged >18 years (mean age 75-80years). Some evidence was found that patients discharged from a NLU are better prepared for discharge, but it is unclear if this is simply a consequence of an increased length of inpatient stay. No statistically significant differences in adverse effects were noted but the possibility of increased early mortality could not be discounted. The authors conclude that more research is needed. At longest follow up(3-6months) there was no statistically significant difference in the proportion of patients in institutional care [45,56].

### **Advanced practice nurse-centered discharge planning and home care intervention**

This service for at-risk hospitalized older people was studied in a RCT in 1999 which showed fewer readmissions, longer time between discharge and readmission, and decreased costs of providing health care [57]. However, a Cochrane review from 2004 on individual discharge plans compared to usual discharge failed to detect differences in mortality, length of hospital stay, readmission rates, and how often patients were discharged from hospital to home [58]. An update from 2010 suggests

that a structured discharge plan tailored to the individual patient probably brings about small reductions in hospital length of stay and readmission rates for older people admitted to hospital with a medical condition. The impact of discharge planning on mortality, health outcomes and cost remains uncertain [59].

### **Geriatric Day Hospital, GDH**

GDH is part of the geriatric specialist health care. It has been an important element of international geriatric medicine for more than four decades. The GDH offers a comprehensive outpatient geriatric assessment and multi-disciplinary rehabilitation for frail older people living at home. However, concerns about the costs of GDH have been rising, and the non-pay travelling costs and the low total amount of training of the patients may not be enough for optimal rehabilitation outcomes. A recent review concluded that the GDH model delivers similar rehabilitation outcomes to HBR, but the GDH service is more resource demanding [60]. A Chinese study showed that the functional independence was not maintained six months after discharge from a GDH [61]. Since rehabilitation services for older people can probably be delivered better and cheaper in other rehabilitation facilities than the GDH, the best utilization of the GDH in the future might be as falls-, multi-pharmacy- and memory clinics and for rapid assessments to avoid hospital admissions [60].

### **Concluding remarks of the literature review**

The Cochrane review referred to in the introduction to this section concluded that there is insufficient evidence to compare the effects of care home versus hospital or own home environments on older persons rehabilitation outcomes, mainly due to too poor descriptions of the services in the specific studies [27]. However, there is good evidence from high quality studies that intermediate care based services, like community hospitals, some early discharge models and home-

based rehabilitation, do improve independency and quality of life for older disabled patients. Some studies also report on reduced mortality and institutionalization.

We only found one study based on a pure primary care nurse-led and GP-based inpatient care unit. This study showed that health functioning, use of services and patient satisfaction in patients aged > 65 years were similar in the intervention group as in the comparison group of conventional care [62]. However, in these units the patient's GP was also clinically responsible for the patient inside the unit. This implied that personnel had to take advices from many GPs, which might have challenged the uniformity of the rehabilitation program, and thus a possible weakness of the model.

A special feature of the present project is that it is based on primary health care resources only. We wanted to find out if this rehabilitation model, which is multi-disciplinary, systematic, with high activity time and based on the generally recommended principles of rehabilitation, could improve the independence and quality of life for older disabled people in their own municipality.

## Section III. Presentation of own research project

### The interventions

#### Reasons for choosing the rehabilitation models in the present study

In 2004 a dedicated inpatient primary care rehabilitation centre was established in the Norwegian municipality of Larvik. The centre adopted the definition of rehabilitation described in the Norwegian Government White Paper, No 21, and only patients assessed in a standardized manner to have a rehabilitation potential were admitted. To the best of our knowledge we found no information about the outcome and costs of such a primary care rehabilitation model. On that background we decided to evaluate this model, named “Primary Care Dedicated Inpatient Rehabilitation” (PCDIR) model and chose this as the intervention model. The PCDIR offers rehabilitation post-acute after discharge from a hospital as well as to older people living at home and who experience health problems that result in need for rehabilitation.

Rehabilitation of older disabled people in short term-beds in nursing homes is widely practiced in Norway. This model, named “Primary Care Nursing Home Rehabilitation”, (PCNHR), was therefore the most appropriate standard rehabilitation model to use for comparison. Also in the PCNHR model older people are admitted post-acute from hospitals and from their own homes. However, the short-term nursing home beds are not only used for rehabilitation patients but also for patients in need of relief or palliation. This means that the personnel frequently has to change focus between rehabilitation and care, and this makes it more difficult to create the active and stimulating environment which according to the WHO ICF Rehabilitation cycle is a prerequisite for successful rehabilitation. A full multi-disciplinary team with occupational therapists and physiotherapists is not always available in PCNHR.

Post-acute care-home rehabilitation compared to usual health and social care did not reduce institutionalization in a British RCT (n=165) [63].



## **Primary Care Dedicated Inpatient Rehabilitation, PCDIR, Model 1**

### **Reference**

Patients can be referred from hospitals and from their own homes to PCDIR by physicians, physio- or occupational therapists or nurses. References from other professionals than a physician must be supplied by a documentation of the medical situation of the patient.

### **Admission**

Patients with physical and/or minor cognitive disabilities can be admitted if they are assessed to have a rehabilitation potential [12]. The assessment is made in a standardized way by a multi-disciplinary team working at the centre, which include a general practitioner (GP), a nurse and an occupational- or physical therapist. The assessment is based on a total evaluation of the functional possibilities and limitations according to each of the elements in ICF. In this work the ADL scores and assessments of the medical, cognitive and emotional status are useful. The cut-off scores of the SI and the MMSE are discussed in the chapter “Key variables”, page 35-37. As for the general medical status patients with severe Chronic Obstructive Pulmonary Disease GOLD classification IV, unstable angina pectoris and undiagnosed cardiac arrhythmias are assessed not to have a rehabilitation potential and are not admitted. Patients with active psychosis or with severe depressions with a lack of initiative are neither not admitted. Admitted patients have to sign a written consent to take part in an active rehabilitation process.

### **Professionals and dimensions of the rehabilitation centre**

The professionals of the centre are physical therapists(four full time), occupational therapists(three full time), nurses and nurse assistants, a social worker(full time) and an experienced GP (half time). Speech therapists, neuro psychologists and other specialized professionals are hired according to the needs.

The centre has 16 beds. The centre also runs various ambulatory training groups and pre-designed rehabilitation stays for patients with specific diagnoses, but these services were not a part of the study.

### **The rehabilitation process**

PCDIR is characterized by a dedicated setting, a multi-disciplinary team working with rehabilitation only, and always focusing on rehabilitation, a standardized rehabilitation process and use of measurement scales, an intensive training and a close dialogue with the patient, her relatives and past and future care givers. The rehabilitation environments are encouraging, active and social.

On admission to the centre the patient has already been judged to have a rehabilitation potential, through a standardized assessment ("Rehabilitation potential", page 18-19). The patient is introduced to a multi-disciplinary team and is encouraged to formulate the goal of the rehabilitation. The centre GP performs a clinical examination and medical assessment of the patient. According to the the specific disability, ADL score, cognitive status and the general medical status, the multi-disciplinary team and the patient in cooperation identify goals for the rehabilitation and develop a rehabilitation plan to reach these goals. The multi-disciplinary team adjusts the rehabilitation plan according to the patient's progress in weekly meetings, always in close collaboration with the patient, the relatives and possible future care givers. The training takes place under the leadership of a physio- or occupational therapist, in one-by-one sessions(60 minutes x 5 days/week) and in groups sessions(30 minutes x 4 days/week). The training is generally focused on improvement in muscular strength, mobility, intensity and on functional exercise. The patients are continuously encouraged to practice self-training, and most of them do. They are trained daily in all ADL-situations, by an occupational therapist, nurse and/or care assistant(1.5 hours every day). This makes a daily training program of three hours in total.

Visits to the patient's home are organized as soon as the patient is capable for it, either as day visits or over-night stays.

The rehabilitation period is not terminated until the patients are considered fit for returning home or the functional gain has stopped. The discharge is carefully planned in a close dialogue between the multi-disciplinary team, the patient, the relatives and possible future care givers. A written multi-disciplinary report is sent to the referring institution, the patient's GP and other relevant care givers.

### **Primary Care Nursing Home Rehabilitation, PCNHR, Model 2**

PCNHR always takes place in short term beds in nursing homes. As for PCDIR only patients assessed to have a rehabilitation potential, were included in the study. As a rule admissions to short-term rehabilitation beds in nursing homes are also decided by a multi-disciplinary team. However, patients with different needs are competing for the same short-term beds whether rehabilitation, relief or palliation, and the same multidisciplinary team decides which patients to offer long-term accommodation in nursing homes. The PCNHR decision making teams consisted of at least two nurses in 100% of the teams, a physiotherapist in 80%, a GP in 60%, and a dedicated case-workers in 65% of the teams. None of teams had an occupational therapist.

### **Professionals and dimension of the PCNHR**

The multi-disciplinary rehabilitation team of the PCNHR was lower dimensioned than in the PCDIR, in total three full time physical therapists and two full time occupational therapists.

### **The rehabilitation process**

The PCNHR patients are also connected to a multi-disciplinary team, but baseline ADL-scoring of the patients are done more occasionally, as are scoring according to other scales. The nursing home GP carries out a clinical examination and medical assessment of the patient. The structure of the rehabilitation process is not as fixed as in PCDIR: Goal-setting, plan-making, evaluation and adjustment of the plan, home visits, discharge planning and the collaboration between the patient, the relatives and the professionals are done in a less systematic way.

The training is done according to the same principles as in PCDIR, but is less intensive, in total two hours per day.

The professionals in short-term nursing homes are challenged by a frequent shift in focus between rehabilitation and care. This makes it difficult both for the personnel and the patients in rehabilitation to keep up the active and positive atmosphere that is important for a successful rehabilitation.

## Key variables

### Sunnaas ADL Index, SI

We wanted to identify outcome measures which covered all the six categories of ICF. A key variable in rehabilitation is functional ability, also described as level of independence or dependence, and often measured by ability in Activities of Daily Living (ADL). Physical impairments and functional limitations have a considerable impact on dependence in activities of daily living. Dependence in ADL is generally associated with a lower maximal walking speed, grip strength, knee extensor strength, stair-climbing capacity and forward reach than in those who are independent in ADL [64].

We chose the ADL-scale, Sunnaas ADL Index, SI [65], as the primary outcome measure. Sunnaas ADL Index is a validated scale, and the correlations between patients' and carer's scores are good [66]. SI measures 12 basic activities of daily life and covers "activities" in ICF. The activities are eating, toilet-management and continence, dressing and undressing, grooming, bath/shower, transfer, indoor and outdoor mobility, cooking, housework and communication. Each activity has a score from 0-3, where 0=totally dependent and 3=independent. The total max score of 36 means totally independent. The patients were scored at the beginning and end of the rehabilitation and at three and 18 months follow-up. Scores <12 means that the patient needs help from one or more persons in nearly all ADL situations which in most cases indicates a marginal rehabilitation potential. However, patients with <10 in SI scores and who are rapidly improving the scores, such as many of the stroke patients, certainly have a rehabilitation potential. The majority of the patients had SI scores between 20-25 when entering the rehabilitation. A 20% improvement in SI from the starting level meant a change from dependent to independent in two to four ADL-situations. Based on this fact and on clinical experience, a 20% improvement in SI was judged to be clinically significant. The inter-item consistency between the more frequently used Functional Independence Measure (FIM) and SI is high for many items, but differences are also identified [67]. We considered SI, which was the ADL scale of general use in primary health care in this county, adequate for meeting the primary aim of

the study. SI is simple to score and easy to interpret, which is important in a primary health care setting.

### **Umeaa Life Satisfaction Checklist, LSC**

Quality of life or life satisfaction is another key variable in rehabilitation. Disabling events have an impact on the quality of life [68]. There are also indications that the rehabilitation strategy influence the experienced quality of life [69]. Umeaa Life Satisfaction Checklist, LSC [70] was chosen as a secondary outcome measurement, covering “Participation” in ICF. LSC is a simple and validated questionnaire, and we decided to use two of the questions, LSCa and LSCb respectively, (LSCa: How satisfied are you with your life in general? LSCb: How satisfied are you with your ability to manage your self-care?). The LSC scale is linear and score 1 means not satisfied and score 6 means highest degree of satisfaction. Scores 1-3 are degrees of “not satisfied”, and the scores 4-6 are degrees of “satisfied”. LSC was also chosen as a possible predictor of outcome. It was registered at the end of the rehabilitation period and three months later.

### **Mini Mental Status Evaluation, MMSE**

Cognitive and emotional status can influence the rehabilitation outcome, and scales measuring these conditions were chosen as possible predictors of the outcome, and covered the fields “Body functions”, “Body structures” and “Personal factors” in ICF.

The validated and widely used Mini Mental Status Evaluation, MMSE [71], was chosen as the cognitive scale. Scores are from 0-30. The cut-off scores to dementia is a matter of debate, but scores of 23/24 with a sensitivity of 0.96 are described [72]. However, patients with hip-fracture and mild (MMSE score 18-23) or moderate dementia (MMSE score 12-17) can often return to their own homes after an active geriatric rehabilitation [73,74]. Walking independence can also be maintained

at one year after the rehabilitation, although less frequently than in individuals with better cognitive function[75]. Older patients with impaired cognitive function and disabilities due to different diagnoses have also been shown to benefit from geriatric inpatient rehabilitation[76]. However, an American longitudinal study (n=231) describes that even if cognitively impaired hip fracture patients experienced some recovery at early follow-up, they were unable to retain rehabilitation gains at one year following post-acute rehabilitation, and they required human assistance to stay in their homes within the community[77]. In our study we were hesitant to assess patients scoring <18-20 in MMSE as having a rehabilitation potential, but if the pre-rehabilitation motor ability was good, they were included. MMSE was recorded two weeks into the rehabilitation period to exclude incidental confusion during the first days of the accommodation.

### **Symptom Check List-10, SCL-10**

Symptom Check List-10, SCL-10 [78,79] is a validated questionnaire mapping emotional health during the previous week, particularly anxiety and depression. SCL-10 covers "personal factors", "bodily functions" and "structures" in ICF and was chosen as a possible predictor of outcome. The scale comprises ten questions with scores from 1-4. The final score is the total score sum divided by ten. Scores>1.85 indicate severe emotional problems. SCL-10 was recorded two weeks into rehabilitation to avoid possible emotional instability at the beginning.

### **Other key variables**

Other key variables were the rehabilitation Length of stay (LOS) and the level of at-home care services and care from relatives. The scores for at-home care were: 1=0 hour/week, 2=>0-3 hours/week, 3=>3-6 hours/week, 4=>6-9 hours/week, and 5=>9 hours/week. These scores were recorded at the end of the rehabilitation stay and at three months follow-up.

During the follow-up we recorded the number of days in hospital and short-term nursing homes and death. The key variables recorded at 18 months follow-up were the SI scores and the residential status.

## **A theoretical model for the association between dependent and independent variables**

The key outcome in rehabilitation is functioning, which in this study was measured by the ADL-scale SI. It is generally agreed that the possibilities of a disabled person to restore, keep or develop the best possible level of functioning are dependent of his/her physical, cognitive and emotional resources. According to this theory the cognitive and emotional status are important independent factors that can influence the dependent functional outcome positively. We would also expect a high positive correlation between life satisfaction and the emotional status, thus also a possible positive association between the life satisfaction scores and functional scores. Furthermore it was interesting to explore possible predictors of the level of at-home care services as another dependent variable. We would expect a high negative correlation between the level of at-home care services and the level of ADL. This would also mean that the independent variables that were expected to influence the level of ADL positively would probably influence the level of at-home care services negatively.

However, a core question in this study was if the data gave us the possibility to find statistically significant predictors. The background for this question was that the patients selected into the study were assessed to have a rehabilitation potential, which means that they already had the resources necessary to improve functioning. It was therefore a possibility that the range in independent variables scores in this study was too small to influence the dependent variables statistically significant. Due to the same reasons another possibility was that we in this study only were able to indicate the strong predictors of the outcome. Theoretically, it was therefore a possibility that the predictor analyses would not result in any statistically significant predictors.



## The research questions

- a. Is rehabilitation of older disabled people in Primary Care Dedicated Inpatient Rehabilitation(PCDIR) effective in terms of a clinically and statistically significant gain in ability of Activity of Daily Living(ADL), which will persists three months after the rehabilitation? Is this outcome different from or better than in Primary Care Nursing Home Rehabilitation (PCNHR)?
- b. What is the rehabilitation length of stay (LOS) in PCDIR compared to in PCNHR?
- c. What is the patients' level of life satisfaction at end of the rehabilitation and at three months follow-up in PCDIR compared to in PCNHR?
- d. What is the level of at-home care services and care from relatives at end of the rehabilitation and at three months follow-up in PCDIR compared to in PCNHR?
- e. How does life satisfaction, mental and emotional status and patients' characteristics influence the ADL gain and level of care at discharge and at three months follow-up in PCDIR and in PCNHR?

The research questions a-e were answered in the study papers:

Johansen I, Lindbaek M, Stanghelle JK, Brekke M. **Effective rehabilitation of older people in a district rehabilitation center.** *J Rehabil Med* 2011 Apr; **43**(5): 461-4.

Johansen I, Lindbaek M, Stanghelle JK, Brekke M. **Structured community-based inpatient rehabilitation of older patients is better than standard primary health care rehabilitation – an open comparative study.** *Disabil Rehabil* 2012; 34(24):2039-2046.

- f. What are the levels of ADL of disabled older patients 18 months after primary care rehabilitation, and are these levels different in the PCDIR compared to the PCNHR model?

- g. What are the number of days in hospital and short-term nursing homes, institutional residence rate and mortality during 18 months after PCDIR and PCNHR rehabilitation, and are there any differences between the two models?
- h. How are the level of ADL and the number of days in short-term nursing home at 18 months follow-up after primary care rehabilitation of older people influenced by patient characteristics, baseline cognitive and emotional status, diagnoses and the rehabilitation model?
- i. What are the costs of the rehabilitation, at-home care services, days in hospital and short-term nursing homes in PCDIR compared to PCNHR during the 18months study period?

The research questions f-i were answered in the study paper:

Johansen I, Lindbaek M, Stanghelle JK, Brekke M. **Independence, institutionalization, death and treatment costs 18 months after rehabilitation of older people in two different primary health care settings.** BMC Health Services Research.2012, 12:400. DOI: 10.1186/1472-6963-12-400.

## Material and methods

### The study design

The study design was an open, prospective, comparative observational study. This design challenge the validity of the study results compared to a randomized design. However, a randomized design was not possible in this case. Our study was carried out in a “real-world clinical environment” [15], and neither the community administrations nor the patients would have accepted a randomization between the two rehabilitation models. A study of a level 2 design was our nearest option to achieve more knowledge about this important and poorly investigated field. The Transparent Reporting of Evaluations with Nonrandomized Designs, TREND, statement provides criteria for addressing the quality of nonrandomized studies in a way that is comparable to the Consolidated Standards of reporting Trials, CONSORT, statement developed for randomized studies [80,81]. The TREND statement includes blinded assessment, the use of valid, reliable, and relevant measures sensitive to change over time, adequate length and timing of follow-up, and adjustments for selection bias [15]. Well-designed evaluation studies may thus give a more externally valid picture of the outcomes and effectiveness of alternative services in actual practice compared to randomized studies.

In the present study the assessment of the patients were partly blinded, which was a challenge to the internal validity of the study, when it comes to both selection and information bias. The professionals of the PCDIR did blinded assessments, but the two project workers in the PCNHR (who included 25 patients) and the project leader did not.

The measurement scales were valid, reliable, relevant and sensitive to change over time. SI is not widely used, but it is the most commonly used ADL-scale in primary health care in the study county. The inter-item consistency between the internationally commonly used FIM and SI is high for many items, even if differences also do exist [67]. It is our opinion that when clinically significant improvements are defined for different types of ADL-scales, it is also possible to compare improvements in level of independence scored by different ADL-scales'. SI is simple to score and easy

to interpret, which are important features of recommended measurement scales in the primary health care. The rehabilitation period of this study and the follow-up at three and 18 months are considered to be adequate.

For practical reasons the patients in the two models were recruited during different time periods. This could have introduced a selection bias into the study. However, the time difference was too small to challenge the demography, and the rehabilitation procedures in the study districts did not change during the study period. Furthermore a scientific rigor of the study was that the two groups were equivalent in terms of characteristics generally associated with rehabilitation outcomes, such as cognitive and emotional status, baseline patient characteristics and diagnoses. Both recruitment districts also had the same number of inhabitants and a very similar demography and urban and rural distribution. Furthermore, all participants were considered to have a rehabilitation potential, and this potential was assessed in the same way in the two models.

### **The statistics**

Data were analyzed in SPSS version 16.0 for Windows (Study paper I and II) and version 19.0 (Study paper III). The estimates were given with a 95% Confidence Interval(CI) and p-values. A 5% level of significance was chosen for all analyses.

Descriptive data were given by means with standard deviations and/or CI and by percentages.

The primary outcome, SI, is a continuous variable and the data from the SI scores were symmetrically distributed. The SI scores from the two study groups could therefore be compared by T-tests. More than two groups of continuous, symmetrically distributed data were compared by one way ANOVA (posthoc test if  $p < 0.05$ ). Asymmetrically continuous variables, such as the at-home care scores, were compared by the Mann-Whitney Wilcoxon-test. Correlations between continuous variables were analyzed by Pearson's (symmetrical distribution) or Spearman's (asymmetrical distribution) correlation coefficient. Categorical variables were compared by Pearson's  $\chi^2$  test. Differences in SI

gain between the groups were analyzed by ANCOVA (Analysis of covariance) to correct for SI imbalance at baseline [82]. Univariate regression analysis was used to explore predictors of outcome. Statistically significant predictors were analyzed in multiple linear regression analysis to identify confounders and true predictors of the outcome. Survival was analyzed by Kaplan-Meier analysis.

### The study participants and recruitment procedures

The study participants of PCDIR were recruited consecutively as they entered the rehabilitation centre and met the inclusion and not the exclusion criteria. 6% of the patients admitted to the rehabilitation centre during the study periode (19 of 316 patients) were not assessed for inclusion due to absence of the project leader. Although these patients represented an interruption of the consecutive recruitment procedure, we could not think of any reason that this minor irregularity would disturb the study results. All the 202 eligible patients gave informed consent to participate in the study on admission to the centre. The recruitment of the PCDIR patients is shown in the flow chart of Fig. 2.

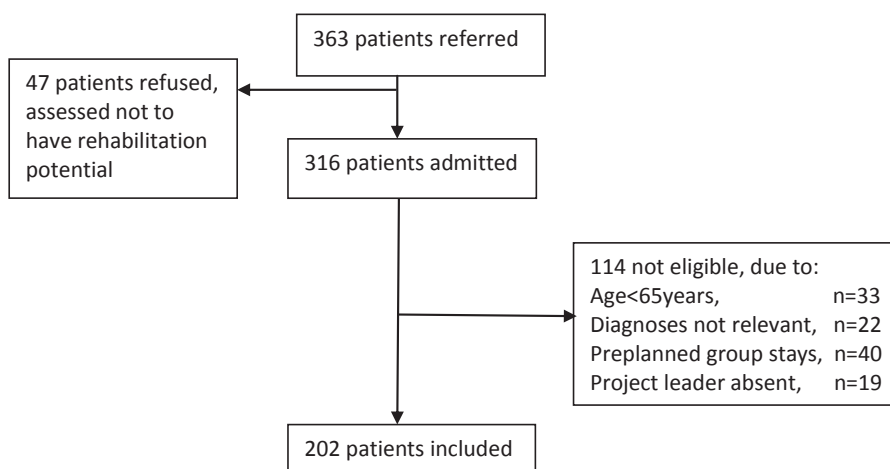


Fig 2. Flow chart of the recruitment of the patients to the PCDIR

The number of patients in PCDIR admitted from home and district general hospital according to different diagnostic groups are shown in Table 1.

**Table 1.** Number of patients in PCDIR admitted from home and from district general hospital according to different diagnostic groups

| Diagnostic group          | Admitted from |                  | Excluded <sup>1</sup> | Total |
|---------------------------|---------------|------------------|-----------------------|-------|
|                           | Own home      | DGH <sup>2</sup> |                       |       |
| Stroke                    | 18            | 16               | 1                     | 35    |
| Hip fracture              | 25            | 57               |                       | 82    |
| Osteoarthritis            | 10            | 13               |                       | 23    |
| Other diagnoses           | 40            | 21               | 1                     | 62    |
| Sum all diagnostic groups | 93            | 107              | 2                     | 202   |

1.Excluded shortly after admission due to serious medical conditions

2.DGH=District General Hospital

The PCNHR patients were recruited on admission to the short-term rehabilitation beds in nursing homes or at the beginning of rehabilitation in their own homes (8 out of 100 patients). The recruitment procedure of PCNHR was that the personnel in charge of the rehabilitation in each of the six municipalities informed the project assistants or -leader consecutively about candidates meeting the inclusion criteria. The 8 PCNHR patients which were rehabilitated at home had a higher mean level of ADL at the beginning of rehabilitation compared to the patients rehabilitated in short-term beds in nursing homes. That is why they were assessed to receive the rehabilitation at home. Since the PCNHR districts also practised home based rehabilitation(HBR) to a small extent, and since the patients receiving HBR were suggested for inclusion by the district rehabilitation personnel, we decided not to exclude them, mainly to avoid a negative influence to the PCNHR results.

14 of the 100 PCNHR patients received specialized inpatient rehabilitation immediately before they entered the PCNHR. These patients were included in the study after the same considerations as for the patients receiving home based rehabilitation.

We were not able to make a flow chart of the recruitment of the PCNHR patients since the district rehabilitation personnel could not give the numbers of the patients that had been assessed for rehabilitation, but were not included. However, all but one of the eligible PCNHR patients gave informed consent to participate in the study, which means that there was no selection bias at this level. Furthermore we have no reasons to believe that the district rehabilitation personnel did not assess the patients consecutively, as the project leader was in close contact with the chairs of the rehabilitation personnel during the recruitment period. The participants in PCDIR were recruited from June 2006 to October 2007, and in PCNHR from December 2007 to April 2009. It is pertinent to ask why the recruitment period was the same in the two models when twice as many patients were included in PCDIR compared to PCNHR. The answer is that there was an interruption in the recruitment process in PCNHR model from June to November 2008 because two project assistants stopped the recruitment without reporting. In this period a number of PCNHR patients were rehabilitated without being included into the study, which introduced a risk of selection bias. However, as discussed above, this time interval was too short to challenge the demography, and the rehabilitation procedures in the study districts did not change during the study period. About half of the patients in each model were referred to post-acute rehabilitation from the same general hospital and the other half directly from their own homes.

All eligible patients were asked and all but one accepted (in PCNHR) and gave informed consent to participate in the study. Patients in PCDIR gave consent shortly after admission to the rehabilitation centre. Patients in PCNHR gave consent either at discharge from the district general hospital, shortly after admission to the short-term beds in nursing homes or in their own homes, before the start of rehabilitation. Two of the patients in PCDIR were excluded shortly after inclusion due to a serious stroke and a leg amputation, respectively. Two patients were lost to follow-up at 18 months. Due to

the low number of withdrawals there was no need to analyze this item. 17 patients were dead at three months follow up and 26 more at 18 months, a total of 43 dead patients during the study period. The difference in mortality in the two models was not statistically significant. The 15 patients in PCDIR and the four patients in PCNHR, who died or were excluded up to three months follow-up, did not differ from the 187 and 96 remaining patients regarding SI at baseline or LSC-scores. At 18 months follow-up 43 of the 298 patients (Excluded=2, Lost to follow-up=2) were dead. In both groups the patients who died were older than the surviving ones and had lower SI at the beginning and end of the rehabilitation period.

### **Inclusion and exclusion criteria**

Study inclusion criteria were both genders, age  $\geq 65$  years, and the diagnoses were stroke, osteoarthritis, hip fracture and “others” (aging disability, loss of function due to long period of hospitalization, other chronic, slowly progressing diseases). Our aim was to study the outcome of rehabilitation of older people with disabilities without regard to diagnoses. However, patients with highly progressive diseases were excluded to minimize the influence of the specific diagnosis on the rehabilitation outcomes. Only patients assessed to have a rehabilitation potential were included. As for the exclusion criteria we followed the admission procedures of the PCDIR, described in the chapter “The interventions”, page 30.

### **Reliability and validity of the data**

Since the patients in this study were not randomized to participation into the two different interventions, there was a danger of selection bias that could challenge the internal validity of the study. However, the close similarities between the two groups in terms of patient characteristics, diagnoses and cognitive and emotional status confirms that there has been a balanced selection of participants. No drop-outs and only two patients missed to follow-up was also a strength to the



internal validity. There was a danger of information bias as the assessment of the PCNHR patients was not blinded. But this risk was small since the measurement scales were validated, simple to score and easy to interpret, and the correlations between patients' and carer's scores in SI are good .

We have to take into account that the PCDIR took part in new buildings, which were located in nice surroundings in the countryside, and with a fresh and enthusiastic personnel. The model is based on the ICF and the WHO rehabilitation cycle, and it is our opinion that these principles represent the backbone of the service provided.

As for the statistical validity of the study we included higher number of patients than estimated from the power calculations due to the planned subgroup analyses of the participants. The main results of the study were presented by effect estimates, confidence intervals and p-values and thus were valid statistical analyses.

The lack of a randomized study design might question the external validity of the study results.

Conclusions from a single study should furthermore be confirmed by other studies of a similar intervention to strengthen the validity of the study results. However, the exclusion criteria of the study were few, which was a strength for the generalizability. Furthermore the study had no drop-outs, and the number of patients excluded or missed to follow-up was also very small. During the project period the older people referred to rehabilitation were assessed according to the same standardized procedures in both districts, and only those assessed to have a rehabilitation potential were included. Therefore we could not find any evidence that patients included in the present study had a higher or lower rehabilitation potential than patients in general standardized rehabilitation.

There is also no evidence that patients with a high or low rehabilitation potential were preferred for a particular rehabilitation model in our study. The two study districts had a similar rural and urban distribution. However, it can always be questioned if patients and their families and carers from more sparsely or densely populated areas compared to the study districts have different attitudes to rehabilitation, which could influence the external validity of the study. On the contrary, most older

people, whether they live in rural or urban areas, have a strong desire to live at home with the best possible independence and quality of life. It is likely that this desire has a higher impact on their motivation than the population density of the district they live in, which could be an argument for the generalizability of the study results.

## Synopsis of the study papers

### Synopsis of study paper I

#### Rehabilitation of older people in a district rehabilitation center is effective

The aim of this study was to assess the outcome of multi-disciplinary primary care rehabilitation of older patients in a dedicated inpatient rehabilitation centre, PCDIR. In this centre rehabilitation was conducted according to the International Classification of Disability, Functioning and Health, ICF, and the principles of the WHO Rehabilitation Cycle. 202 older patients were recruited, living in the municipality of Larvik (40.000 inhabitants), in the county of Vestfold, Norway. They were all admitted to the municipality rehabilitation centre, either post-acute from the district general hospital in Vestfold or from their own homes.

The study participants were aged  $\geq 65$  years, assessed to have a rehabilitation potential, and the diagnoses were stroke, osteoarthritis, hip fracture and other chronic diseases. The multi-disciplinary team included physio- and occupational therapists, nurses and their assistants and an experienced general practitioner (GP). The primary outcome was gain in Activities of Daily Living during rehabilitation and its level of persistence at three months follow-up. The measurement scale used was Sunnaas ADL Index (SI). The secondary outcome was Life Satisfaction measured by Umeaa Life Satisfaction Checklist (LSC). Cognitive (MMSE) and emotional (SCL10) status were recorded as possible predictors of the rehabilitation outcome. Patient characteristics were recorded, as well as rehabilitation length of stay (LOS) and hours/week at-home care services and care from relatives. SI increased 4.2 (95%CI(3.5-4.8),  $p < 0.001$ ) during the mean 3.1 weeks LOS, persisting after three months. 84 % of the patients scored to be satisfied according to LSC at the end of rehabilitation and three months later. SI at discharge (adjusted for SI at admission) was predicted by MMSE. 74% of the patients needed home care services  $< 3$  hours/week, at discharge and three months later. The level of home care services were predicted negatively by the MMSE scores.

In conclusion rehabilitation of older patients in Primary Care Dedicated Inpatient Rehabilitation(PCDIR) is effective in terms of a clinically and statistically significant gain in ability of Activities of Daily Living(ADL), which persisted at three months after the rehabilitation. The level of life satisfaction was positive at end of the rehabilitation and at three months follow-up. The cognitive status influenced the ADL gain positively and the level of care negatively.

## **Synopsis of study paper II**

### **Structured community based inpatient rehabilitation of older patients is better than standard primary health care rehabilitation - an open comparative study**

The aim of this study was to compare the outcome of multi-disciplinary rehabilitation of older patients in Primary Care Nursing Home rehabilitation, PCNHR, to Primary Care Dedicated Inpatient Rehabilitation, PCDIR. The PCNHR was less structured and less intensive compared to the PCDIR. The PCNHR patients lived in another district in Vestfold, Norway, with the same number of inhabitants and a similar demographic and rural and urban distribution as the PCDIR district.

Totally 302 patients were included in this second study, 202 in PCDIR and 100 in PCNHR. The inclusion criteria and outcome measurements were identical to those applied in the first study. We wanted to compare the gain in SI and its persistence at three months follow-up in the two models, the rehabilitation length of stay(LOS), the level of Life satisfaction and at-home care services and predictors of the outcome.

Baseline patient characteristics, the distribution of diagnoses and the cognitive and emotional status in the two models were not statistically different. Mean age was 80 years and 2/3 of the patients were women. 85% lived in their own homes, 15% in care flats. 60% lived alone. Baseline MMSE scores were 25 and SCL10 scores 1.4. In both groups the women were older and lived alone more frequently than the men.

Patients in PCDIR improved and persisted 1.9 points higher in SI (95%CI(1.0,2.8),  $p<0.001$ ) compared

to PCNHR, within 2.4 weeks shorter rehabilitation (95%CI (1.6,3.1),  $p<0.001$ ). LSC indicated similar and positive satisfaction with life in general and the ability to self-care within both models. Fewer PCDIR patients received home care services > 3hours/week (OR=0.6, 95%CI(0.4,0.8),  $p=0.002$ ). The MMSE scores predicted the SI gain positively, and level of home care services negatively, in both models. The level of home care services was also predicted negatively by Satisfaction with ability to self-care, in both models.

In conclusion disabled older patients nearly doubled their level of Activities of Daily Living within nearly half the rehabilitation time upon structured, multi-disciplinary rehabilitation in PCDIR, compared to standard primary care rehabilitation in PCNHR. The patients in both models scored to be satisfied and to the same degree according to LSC. The PCDIR patients needed significantly lower level of home care services compared to the PCNHR patients. At three months follow-up the home care services equaled the care from relatives in the PCDIR model, while it was significantly higher in PCNHR. The cognitive status predicted the SI gain and its persistence positively, and the level of home care services negatively, in both models.

### **Synopsis of study paper III**

#### **Independence, institutionalization, death and treatment costs 18 months after rehabilitation of older people in two different primary health care settings**

This was an 18 months follow-up of the previous studies. The primary outcome measure was SI. Secondary measurements were number of days in hospital and short-term nursing homes, institutionalization, measured by institutional residence rate, and death; baseline Cognitive(MMSE) and Emotional(SCL10) scores and number of days in rehabilitation; costs per patient in rehabilitation and for at-home and institutional care.

Overall SI scores were 26.1 (SD 7.2) at 18 months follow-up, which was a statistically, but not clinically significant reduction of 0.9 point (95%CI(0.3-1.5),  $p=0.003$ ) compared to at end of the rehabilitation. The PCDIR patients had 2.2points higher SI scores compared to the PCNHR patients, adjusted for age, gender, MMSE and baseline SI scores (95%CI(0.8-3.7),  $p=0.003$ ). SI was predicted positively by cognitive status in both models.

Overall 66(26%) of the patients had one or more stays in hospital, mean 14 days and no statistically significant difference between the models were observed ( $p=0.1$  Independent Samples T-test).

Ninety-four (37%) of the patients had short-term stays in nursing homes. Forty-five patients had stays of 1-28 days, mean 4 days shorter in PCDIR compared to PCNHR (95%CI(-0.1-7.1)  $p=0.06$ ).

Forty-nine patients had stays of >28 days, mean 105 days shorter in PCDIR compared to PCNHR (95%CI(0.28-209.6),  $p=0.05$ ). The number of short-term days in nursing homes was predicted negatively by cognitive status and SI at end of rehabilitation. Sixteen(11.8%) of the patients aged  $\geq 80$  years resided in a nursing home at 18 months follow-up, (9 (9.8%) in PCDIR and 7(15.6%) in PCNHR), compared to none at baseline. The proportion of patients residing in a care-flat or nursing home increased significantly in PCNHR, (from 12(12.0%) to 25(28.1%) (McNemar,  $p=0.001$ )), but not in PCDIR (from 28(16.9%) to 32(19.3%) (McNemar  $p=0.45$ )).

Forty-three of the 298 patients (Excluded=2, Lost to follow-up=2) died during the study period, giving a one year mortality of 9.6% and no statistically significant difference in mortality between the models ( $p=0.3$ , Pearsons  $\chi^2$  Test).The mortality was higher compared to the general Norwegian population at the same age, but lower compared to in post-acute rehabilitation studies.

Average costs were statistically significant lower for PCDIR as compared to PCNHR. The difference per patient was 3 528€ for rehabilitation ( $p<0.001$ , 95%CI(2455-4756), and 10 134€ for the home care services( $p=0.002$ , 95%CI(4066-16202). Total costs of rehabilitation and home and institutional care were 18 702€(=1.6 times) higher in PCNHR compared to in PCDIR.

In conclusion the SI level of disabled older patients persisted from end of rehabilitation until 18 months follow-up and was 2.2points higher after PCDIR compared to PCNHR. The SI level in both models was positively influenced by baseline cognitive status. One fourth of the patients had hospital stays during follow-up, and the number of days was not significantly different in the two models. One third of the patients had short-term stays in nursing homes, and the patients in PCDIR stayed fewer days as compared to the patients in PCNHR. The institutionalization rate did not increase in PCDIR, however it doubled in PCNHR. The overall one year mortality was 10%. The average costs of the rehabilitation were about 3 500€ lower per patient in PCDIR compared to PCDIR and the average home care costs were about 10 000€ lower. The average total costs per patient for rehabilitation, at-home and institutional care were about 48 000€ in PCNHR, which was 1.6 times higher compared to in PCDIR.

## **General Discussion**

The study design, participants, recruitment procedures, inclusion and exclusion criteria and the reliability and validity of the data are already discussed in the chapter “Material and Methods”, page 41 and 43-48.

We have not been able to identify other studies on rehabilitation of older people carried out in a primary health care dedicated inpatient centre like in the present study. However, the study rehabilitation centre has similarities to intermediate care community hospitals(CH) in UK, Finland, Norway and the Netherlands [52,54] [83,84], which are described in Section II, at page 26.

Rehabilitation models for older people. CH usually have geriatric consultants assigned instead of or in addition to GPs, which is a difference from the PCDIR model. Furthermore in the PCDIR model the patients must be assessed to have a rehabilitation potential to be admitted. This is not the case in CHs where the prerequisite for admission is that the patient no longer needs acute hospital treatment facilities. The rehabilitation resources and intensity are also higher in PCDIR compared to community hospitals. More intensive exercise has been shown to increase the success of hip fracture programmes [85,86].

In the following paragraphs we have discussed the specific outcomes of the study and compared them to corresponding outcomes in other studies of rehabilitation and treatment of disabled older people at the intermediate and specialized health care level. The main results of these comparisons are shown in table 3.

### **Improvement in Activities of Daily Living, ADL**

This study showed that multi-disciplinary primary care rehabilitation of older patients in a dedicated inpatient centre(PCDIR) is effective in terms of a clinically and statistically significant improvement in ADL. Compared to rehabilitation in short-term beds in nursing homes(PCNHR), with smaller multi-



disciplinary resources, a less structured rehabilitation process and lower activity level, the patients in PCDIR improved their level of ADL to a significantly higher degree, and within a significantly shorter time, and the difference in level of ADL between the models persisted until 18 months follow-up.

Patients with stroke in the PCDIR model had the highest improvement in level of ADL. This is consistent with available evidence concerning multi-disciplinary rehabilitation of stroke patients[15]. The higher ADL-gain in the other diagnostic groups in PCDIR compared to PCNHR was not statistically significant, but the rehabilitation LOS in these groups was significantly shorter. This indicates that the efficacy of the PCDIR model was higher for all diagnostic groups studied, visualized in Table 2. However, this study was not designed with the power needed to show differences in outcomes between the diagnostic subgroups, and for the same reason statistical analyses comparing the efficacy estimates was not part of the study.

**Table 2. Efficacy=ADL gain in relation to LOS of PCDIR and PCNHR in diagnostic subgroups**

| Diagnoses      | Efficacy =gain in SI/rehabilitation LOS(days) |               |
|----------------|---|---------------|
|                | PCDIR   | PCNHR         |
| Stroke         | 5.2/28.0=0.20                                 | 1.3/38.5=0.03 |
| Hip fracture   | 5.1/23.1=0.22                                 | 4.0/35.0=0.11 |
| Osteoarthritis | 2.4/19.6=0.12                                 | 2.4/47.6=0.05 |
| Others         | 3.1/17.5=0.18                                 | 3.0/37.1=0.08 |

Loss of independence of older people at six months after discharge from community hospitals in UK and Norway was significantly less likely compared to prolonged general hospital care [53,54], (Table 3, 2-3). In the Norwegian study independence was recorded as “not in need of home care services” and not by change in the ADL score. In the British study the difference in change score at six months follow-up was 3.3 according to the ANCOVA analysis of the 66 points Nottingham Extended ADL scale (NEADL), compared to 2.2 at 18 months follow-up in the present study of the 36points SI scale. This indicates a similar improved functional gain in the intervention group of the British study compared

to in the PCDIR of the present study. However, the follow-up time in the present study was 12 months longer. NEADL is a validated ADL scale and responsive instrument used in several British rehabilitation studies[87,88]. Community-based complex interventions for older people (Table 3, 4) with a mean age of at least 65 years and at least 6 months follow-up compared to usual care also showed better physical function and a lower risk of not living at home [89]. Early supported discharge (ESD) of stroke patients (Table 3, 5) by a specialized mobile team co-ordinated further rehabilitation during one month in cooperation with the primary health care. This service was compared to ordinary stroke unit service. The study showed a higher level of independence of the ESD patients at 52 weeks follow-up [48]. At five years follow-up (Table 3, 6) no statistically significant difference in the independence score between the groups was found, although there was a trend towards a better score in the ESD group [49]. The Geriatric day hospital (GDH) and Home based rehabilitation (HBR) have also been compared in terms of independence and with a fairly similar outcome, however with probably fewer attendancies in HBR [60] (Table 3, 7). Inpatient rehabilitation specifically designed for general or orthopedic geriatric patients compared to usual care was reviewed in 2010 (Table 3, 8). The intervention rehabilitation program was performed according to the ICF and WHO rehabilitation cycle. The functional improvement was higher both in the short and long term perspective, however less pronounced at the long term assessment, which was done at 3-12 months [25]. More elderly hip fracture patients achieved a partial recovery at three months follow-up if they were assigned to a daily multi-disciplinary geriatric intervention in an orthopedic university hospital ward compared to usual care. However, at six and 12 months there were no differences between the groups [90].

In conclusion, studies of both intermediate and specialized geriatric multi-disciplinary, inpatient and out-patient rehabilitation of general geriatric-, orthopedic- and stroke patients report higher short and long term levels of independence compared to standard community or general hospital care. However, the differences in the rehabilitation settings, programmes and the diagnostic groups make a further comparison very difficult.

**Table 3. Improvement in Level of independence, LOS, institutionalization and death after rehabilitation of disabled older people in different settings, diagnoses and follow-up time**

| Intervention                      | Control                      | Patient category                   | Study design                    | Level of independence                            | LOS (days) Int/contr | Long term nursing home Int%/ Contr% | Mortality Int%/ Contr %              | Follow-up time (months =m) | Ref |
|-----------------------------------|------------------------------|------------------------------------|---------------------------------|--|----------------------|-------------------------------------|--------------------------------------|----------------------------|-----|
| 1.PCDIR                           | PCNHR                        | Disabled older people n=302        | Open, prospective observational | 2.2points higher in SI in PCDIR                  | 22/39                | 9.8/ 15.6                           | 9.6 (10.7/ 7.3)                      | 18 m                       |     |
| 2.Community hosp                  | General hosp                 | Post-acute older people n=490      | Multicenter RCT                 | 3.3points higher in NEADL <sup>2</sup> in interv | 22/20                | >40%                                | 26.1/ 30.5                           | 6 m                        | 33  |
| 3.Community hosp                  | General hosp                 | Post-acute older people n=142      | RCT                             | Independent of care 25% vs 10%                   | 28/22                | 9.7/7.1 16.9/14.6                   | 18.1/ 31.4                           | 6 m 12m                    | 34  |
| 4.Community-based complex interv  | Usual care or minimum interv | Disabled older people n= 97984     | Review and meta-analysis        | Better in interv group                           |                      | 11.1 per year                       | RR <sup>1</sup> 1.00 CI(0.9 2- 1.02) | At least 6 m               | 59  |
| 5.ESUS                            | Ordinary stroke unit         | Stroke n=320                       | RCT                             | Independent 56%/45%                              | 28/28                | 11.9/ 15.0                          | 13.1/ 16.3                           | 12 m                       | 30  |
| 6.ESUS                            | Ordinary stroke unit         | Stroke n=158                       | Follow-up of RCT                | Independence no statist. sign difference         | 28/28                | 14/30                               | 45.8/ 51.0                           | 5 years                    | 31  |
| 7.Geriatric day hosp, GDH         | Home based rehab, HBR        | Disabled older people n=894        | Review                          | Independence no statist.sign difference          | Higher in GDH        |                                     |                                      | 3-6m                       | 40  |
| 8.Specialized inpatient geriatric | Usual care                   | General or orthop geriatric n=4780 | Review and meta-analysis        | Better in interv group                           | Average 25           | RR 0.84 CI(0.72- 0.99)              | RR 0.87 (0.77- 0.97)                 | 3-12                       | 14  |

1.RR=Relative Risk 2.NEADL=Nottingham extended ADL index

### Life satisfaction

About 80% of the patients in both models scored to be satisfied with life in general and with the ability to self-care, and no statistical differences were found between the groups. The study population on the whole related their satisfaction with life in general to a lifelong and kind husband

or wife, and faithful children and grandchildren. Generally, the disabling event was given less attention in the evaluation of life satisfaction. It is confirmed in other studies that people of older age emphasize other and more subjective issues compared to the general population when evaluating their life satisfaction [91,92]. Adaptation and resilience are probably important characteristics in maintaining a feeling of well-being in older age. However, physical function and physical activity are also clearly related to feelings of well-being among independent as well as dependent older people [93].

### **Rehabilitation length of stay, LOS**

The LOS in PCDIR is comparable to average stays in community hospitals and specialized inpatient rehabilitation which varied between 22-28 days in the studies presented in Table 3. However, the LOS in PCNHR was substantially longer with 39 days. We believe that the less frequent use of functional scales in PCNHR makes it more difficult to detect progress or stagnation in the rehabilitation process, and that this may explain the longer LOS in this model. Moreover, the PCNHR setting did also not provide an optimal rehabilitation environment.

### **Level of care**

The patients in PCDIR needed lower levels of at-home care services compared to PCNHR. This is consistent with a strong negative correlation between level of ADL and the at-home care services in both models. Interestingly, in PCDIR the relatives cared for the patients to the same extent as did the at-home care services, while in PCNHR the care level from relatives was significantly lower compared to at-home care services. There are no obvious reasons for this difference. In PCDIR, however, the dialogue with the relatives, care givers and the patient was systematically implemented into the rehabilitation process, while this was less systematized in PCNHR. Our findings show that even in Norway, with a high level of public care, the family is an important source of care and support for

disabled older people. In a prospective cohort study of disabled community-dwelling older people informal caregiving was shown to be an important factor in the prevention of overall discontinuation of living at home[94].

Seventy-four% of the patients needed at-home care six months after discharge from a Norwegian community hospital [54] (Tabl 3,3), compared to 70% of the patients in both models in the present study. However, when looking into the details 45% of the PCNHR patients needed >3hours/week at-home care services, compared to 21% of the PCDIR patients. In the Norwegian community hospital study more than half of the patients in both the intervention and the control group needed long-term at-home care at 12 months follow-up [55]. This is comparable to the PCNHR model, but is substantially more than what was needed for the patients who underwent rehabilitation in the PCDIR model. It should be noted that most studies report on “living at home” and “living independently” and not on the specific level of at-home care.

### **Institutionalization**

Due to the disability of the study population, we expected the institutional residence rate at 18 months follow-up to be higher than in the general Norwegian population of the same age. In 2007 14.3% of the general Norwegian population  $\geq 80$  years lived in nursing homes [95]. However, we found that only 9.8% of the PCDIR and 15.6% of the PCNHR patients respectively, lived in nursing homes. Our data indicate that PCDIR, if adopted on a broader scale, may reduce the number of Norwegians  $\geq 80$  years living in nursing homes (in 2007  $n=31.000$ ) by several thousands.

The higher institutional residence rate in PCNHR was also shown by a doubling of the number of patients residing in a care-flat or nursing home during follow-up, while no increase was seen after PCDIR.

At 12 months follow-up in the Norwegian community hospital (CH) study 16.9% of the patients in the intervention group and 14.6% in the control group resided in long-term nursing homes [55] (Tabl 3,

3). Thirteen% of the patients were institutionalized at 12 months follow-up in another prospective cohort study of post-acute care in a CH from Taiwan [96]. These percentages were similar or higher compared to in the general Norwegian population. More than 40% of CH patients at a median age of 86years were reported not to live in their own homes at 3-12 months follow-up in the British multi-center RCT [53] (Tabl 3,2). None of the described studies reported lower institutionalization (Table 3) compared to in PCDIR, which should imply that the PCDIR model was not inferior according to this outcome. However, we are aware that comparison of institutionalization figures from different studies might not be appropriate since the study settings, patient characteristics and the content of the rehabilitation programs are different.

## **Mortality**

The one year mortality of the total study population was higher than in the general Norwegian population at the same age, 9.6% versus 6%, respectively [97] (PCDIR: 10.7%, PCNHR: 7.3%). A Dutch GP-hospital study with patients admitted both post-acute from hospitals and directly from home also reported a mortality of 10% [84], and in the ESUS study of stroke patients it was 11.8% [48] (Table 3, 5). Mortality rates reported after post-acute rehabilitation of older people are frequently found to be around 20% [55,96,98]. Variables associated with a higher mortality are higher age and lower baseline level of ADL [98], which is consistent with our findings. Only half of the patients in the present study were in post-acute rehabilitation, which may explain some of why our mortality rates are lower than in studies on post-acute patients only. Furthermore, the major causes of death in post-acute care patients are cardiovascular, infectious and malignant diseases. Only a few patients with these diagnoses were included in our study [99]. Due to their higher ADL levels, we expected the PCDIR patients to have better survival than the PCNHR patients. Surprisingly, there was a tendency towards the opposite, which was not statistically significant. This may be explained by a higher morbidity among the PCDIR patients, as shown by the need for more days in hospital during the follow-up period. Information about comorbidity would have been of interest for the mortality rate,

but unfortunately co-morbidity scoring of the patients was not done in our study.

### **Predictors of the outcomes**

Irrespective of the type of rehabilitation, cognitive status was a predictor of both the level of ADL, the at-home care services and the number of short-term days in nursing homes. Several studies identify cognitive status as a predictor of rehabilitation outcomes [100-103]. However, in our study neither the emotional - nor the life satisfaction scores were predictors, probably because the scores for patients with a rehabilitation potential were within limits that would not influence the rehabilitation outcome. Age turned out to predict the level of ADL to a small degree, which have also been found by others [102].

The patients who died were older than the surviving patients and had lower SI at the beginning and end of the rehabilitation period, a finding which is consistent with other studies [98].

### **Cost calculations**

The PCDIR intervention was both more effective and less expensive compared to the PCNHR, thus PCDIR meets the criteria for a preferred strategy [104]. In such situations the health-care decisions are obvious and calculation of a cost-effective ratio is unnecessary. The main reasons for the lower costs of the PCDIR were the shorter rehabilitation stay and the lower care needs compared to the PCNHR. The costs of medication, transportation and outpatient physician and physical-therapy visits were not recorded. However, if these costs had been included they would most likely have added to the expenses in PCNHR, according to the lower level of independence in this model.

The costs per day of rehabilitation, short-term nursing home and hospital stays were derived from the official accounts of the specific institution and from Statistics Norway. The given costs per day seems reasonable from a practical point of view. However, at-home care costs given from Statistics Norway are costs per day. The number of hours per day included in the cost estimation of this service

was not available. We therefore calculated the per patient costs/hour of at-home care services from data provided by the community administrations of the study districts. These were based on the average costs of nursing, care, utensils, transportation and administration. Another challenge was that the at-home care services were not recorded in exact hours/week, but in five categories, 1=0 hour/week, 2=>0-3 hours/week, 3=>3-6 hours/week, 4=>6-9 hours/week and 5=>9 hours/week. We transformed the categories into median hours/week, giving category 2=1.5hours, category 3=3.0hours, category 4=4.5hours and category 5=12hours/week. We estimated that these medians did not deviate significantly from the expected means. About 30% of the patients in each model received no Home care services. In PCDIR nearly 50% of the patients received >0-3hours/week Home care services, and a false calculation of hours/week in this category would represent the highest risk of a wrong cost calculation. We know that a majority of the patients in the category >0-3hours/week only had house cleaning assistance 2hours every second week or delivery of medicines once or every second week. This means that the mean hours/week of the at-home care services in this category should not be higher than 1.5. We could therefore be fairly sure that we did not calculate the care costs too low in this category. We also checked the recordings for the about 40 patients in each model in the categories 3, 4 and 5 and found fairly similar means and medians in each category. The distribution of patients in each category is shown in Table 4.

**Table 4.** At-home care services and their costs per week from the end of rehabilitation until 18 months after

|  | At-home care services, categories |                         |                         |                         |                       |         |
|--|-----------------------------------|-------------------------|-------------------------|-------------------------|-----------------------|---------|
|  | 1=0 h/w <sup>1</sup>              | 2=>0-3 h/w <sup>1</sup> | 3=>3-6 h/w <sup>1</sup> | 4=>6-9 h/w <sup>1</sup> | 5=>9 h/w <sup>1</sup> | Missing |
| PCDIR, n(%)  | 56 (30%)                          | 89 (48%)                | 26 (14%)                | 11 (6%)                 | 3 (1%)                | 2(1%)   |
| PCNHR, n(%)  | 30 (31%)                          | 23 (24%)                | 18 (19%)                | 13 (13%)                | 12 (13%)              | 0       |
| Median hours per patient per week                    | 0                                 | 1.5                     | 4.5                     | 7.5                     | 12                    |         |
| Median costs per patient per week NOK/€ <sup>2</sup> | 0 NOK                             | 935NOK/<br>117€         | 2804NOK/<br>351€        | 4673NOK/<br>585€        | 7476NOK/<br>936€      |         |

1.h/w=hours/week 2. Calculated costs of at-home care services were 623NOK/78€ per hour



At-home care services was recorded at the end of rehabilitation and at three months follow-up. We found a very strong negative correlation between the SI and the level of at-home care services with a Pearson's correlation coefficient of -0.7 in PCDIR and -0.9 in PCNHR,  $p < 0.001$ . According to the stable SI level in both models through the 18 months follow-up, we calculated that the level of at-home care services was also stable in the same period.

We calculated the average total costs per patient to be 1.6 times higher in PCNHR during 18 months follow-up. However, if the expected survival time is also considered, the cost differences may be even higher. The remaining life time of a 82 year old Norwegian is about seven years (men: six years, women: eight years) [105].

The cost-saving effects of different rehabilitation strategies are unclear, and it is difficult to compare costs across countries since both the reimbursement systems, delivery agreements and price levels differ. GP hospitals in Northern Norway are likely to provide health care at lower costs than alternative models of care, like general hospitals, nursing homes or at-home care [106]. A Dutch GP hospital was also shown to be a cost-saving alternative for elderly patients in need of intermediate medical and nursing care between hospital and at-home care [107]. An early discharge and rehabilitation service was also shown to be more cost effective compared to usual care in a British RCT [108]. The cost effectiveness was similar in the British multi-center study of post-acute care and rehabilitation in community hospitals compared to prolonged care in general hospitals [109]. The lower one year costs of a Norwegian post-acute community hospital compared to a general hospital might be out-weighed by a higher proportion of the CH patients residing in a nursing home at follow-up [110]. A study of 106 hip fracture patients from Finland showed that about 75% of the first year costs were post-acute, and centralization of post-acute rehabilitation was profitable [111]. Sub-acute nursing homes were more effective than traditional nursing homes in returning stroke patients aged  $\geq 65$  years to the community, but the Medicare costs were higher [112].

Despite the fact that the PCDIR model can be labeled as a preferred strategy, we know that in many countries and areas of the world the public health care system cannot afford to apply such models, and subsequently to give care to disabled older people living at home. Even in Europe there are still many countries where the family is the main provider of care for disabled old relatives. The health care- and welfare systems in Norway is similar to other Scandinavian countries, and to some extent to the Dutch and British systems. The wealth and political systems in these countries make it possible to offer public rehabilitation and care for at-home living older people.

## **Overall evaluation of PCDIR versus PCNHR**

### **Admission**

In PCDIR admission to the unit is decided by a multi-disciplinary team consisting of an experienced GP, a nurse and a physio- or occupational therapist. A prerequisite for admission is that the patient is considered to have a rehabilitation potential after a standardized assessment by the multi-disciplinary team.

In PCNHR the decision making team consists of at least two nurses, but there is not always a GP or a physiotherapist and there was never an occupational therapist. The assessment is less standardized than in PCDIR. The team makes decisions about admissions to short-term beds as well as admissions to long-term residential care. Furthermore, the short-term beds are supposed to harbour patients in need of both relief and palliation and not only rehabilitation.

Having described the admission procedures in the two models, it is pertinent to ask if the patients accepted for PCDIR were better fit for rehabilitation and had a higher chance for functional improvements than patients accepted for PCNHR. Although this might be the case in everyday practice, all participants in the present study were assessed in the same way to have a rehabilitation potential.

### **Appropriate environments**

The dedicated rehabilitation unit in PCDIR makes it easier for the patients and the personnel alike to maintain a focus on rehabilitation. The patients in PCDIR give a written consent to take part in an active rehabilitation process. The general focus is active and optimistic, and the staff stimulates patient participation and do not focus on restrictions and limitations. Patients are highly motivated for achieving functional improvement, and all therapeutic actions are aimed at this. These criteria meet the recommendations given in the WHO ICF Rehabilitation cycle for a beneficial outcome [25]. Other characteristics are building adaptations for disabled persons, availability of instrumental aids and outdoor surroundings that facilitate rehabilitation activities. The PCNHR units house both rehabilitation and care patients at the same time. According to the WHO rehabilitation cycle this makes it more difficult to establish an appropriate rehabilitation environment.

### **The structured dialogue and the rehabilitation process**

In PCDIR the dialogue between the patient, the relatives and the caregivers is close and is organized as formal meetings with regular intervals, at least once a week. The importance of a structured dialogue for a successful rehabilitation has also been emphasized by others including ICF [113]. A close and structured dialogue is a prerequisite for optimal co-ordination of different services which are essential for successful rehabilitation [26].

It is our understanding that regularity and structure in the dialogue between the patient and the rehabilitation team minimize time spending and optimize focusing on the most important actions in the rehabilitation process. The dialogue is also an important tool in the PCNHR model, but a likely consequence of a poorly structured dialogue is that the continuous evaluation and adjustment of the rehabilitation plans will also become less systematic.

The PCDIR model was designed in accordance with the commonly accepted definitions of

rehabilitation. The rehabilitation process in this model includes the main features of the WHO ICF rehabilitation cycle [17], such as: “A multi-dimensional geriatric assessment; stringent assignment to therapies; regular team meetings with all health professionals involved in the care for the patient; goal setting tailored to the individual patient; interventions tailored to the patient’s needs; and regular treatment evaluation with the care team and the patient” [14]. Evidence suggests that rehabilitation for older people involving a coordinated multi-disciplinary team of health professionals and using a comprehensive geriatric assessment, is effective [114,115]. The PCNHR model is also based on the commonly accepted definitions of rehabilitation, but to a less extent than PCDIR. The main features of the WHO ICF rehabilitation cycle [17], is described in more detail in the chapter “Important definitions”, page 17.

### **Measurement scales**

The systematic and frequent use of functional scales in PCDIR demonstrate clearly if and when improvements are achieved [116,117]. This enhances the motivation of the patient and the staff and makes the potentially vague process of rehabilitation more concrete. Improvements or potential stagnations in the rehabilitation process are more easily detected. The functional scores are therefore helpful tools in deciding when the rehabilitation stay is completed. We believe that the frequent use of functional scales is one of several factors that can explain why the rehabilitation stays in PCDIR are shorter than in PCNHR.

### **Activity time**

More time spent in training and activities in PCDIR may explain some of the higher improvements in ADL in this group and is consistent with studies of training intensity and strategies following hip fracture surgery [118,119]. A retrospective study from USA of 5000 patients with stroke, orthopedic, cardiovascular and pulmonary conditions also showed that higher therapy intensity was associated with lower LOS and higher functional improvements [120]. Older stroke patients who received an intensive community-based multidisciplinary rehabilitation service experienced short-term benefit in

relation to social participation and some aspects of health-related quality of life [121]. However, the same intensive service to hip fracture patients did not result in a similar benefit.

In the traditional GDH model (Geriatric Day Hospital), the activity time is estimated to 1.6 hours during a 5.8 hours daily attendance time [122], compared to the 3 hours in PCDIR and 2 hours in PCNHR. Ideally, the rehabilitation intensity, strategy and setting should be tailored to the patient's clinical condition and rehabilitation needs [123]. Hip fracture patients at a mean age of 75 years with no co-morbidity and who did not live alone and were more independent, have been studied. It was shown that five sessions of physiotherapy at home gave at least as good ambulatory outcomes as daily physiotherapy for a month in an inpatient rehabilitation centre [124]. However, in Norway such patients would be referred to ambulatory physiotherapy.

The training intensity may also be too high. A qualitative study showed that stroke patients preferred a lower-intensity training program and rest periods [125]. If an intensive training is not suitable for the patient, this may result in reduced compliance and even adverse events [126-128].

### **Concluding remarks to the overall evaluation of PCDIR versus PCNHR**

The data from the present study do not give evident reasons for the higher and persistent gain in independence in PCDIR versus PCNHR, which resulted in lower needs for at-home care and a lower rate of long-term care in institution. Several features have been presented as contributing factors to the observed differences such as a superior rehabilitation environment in PCDIR, a better dialogue and rehabilitation process, an increased use of validated functional scales and a higher activity level. However, we cannot conclude that these elements are the only reasons for the success of the PCDIR model. But we think it is justified to conclude that the PCDIR model sticks to the key features of the WHO ICF Rehabilitation cycle to a higher degree than what is the case for PCNHR.

## Conclusions

### Answers to the research questions

The following points summarize the main answers to “The research questions” listed at page 39-40.

- Improvement in ADL and rehabilitation LOS: Primary health care multi-disciplinary inpatient rehabilitation of older people in a dedicated unit, PCDIR, improves the ability to manage activities of daily life nearly twice as much within nearly half of the rehabilitation LOS, compared to rehabilitation in short-term beds in nursing homes, PCNHR. The patients in both models maintained the level of ADL until three and 18 months follow-up, and the clinically and statistically higher level of ADL in PCDIR persisted.
- Life satisfaction: The patients in both models scored to be satisfied with life in general and with the ability to self-care with no statistical differences between the groups.
- At-home care services and care from relatives: The patients in PCDIR needed less at-home care services compared to in PCNHR, and the relatives of patients in PCDIR provided a greater share of care for the patients. There was a very strong negative correlation between the level of at-home care services and the level of ADL in both models.
- Predictors of outcome: Better cognitive status influenced the ADL gain positively and the level of at-home care services negatively in both models at end of the rehabilitation and at three and 18 months follow-up.
- Short-term nursing home stays: Among the one fifth of the patients in both groups that stayed >28 days in short-term nursing homes, the patients in PCNHR stayed for substantially more days. The number of days in short-term nursing homes was influenced negatively by the cognitive status and the level of ADL at end of the rehabilitation.

- Institutionalization: The proportion of patients residing in a care flat or nursing home doubled in PCNHR from baseline until 18 months follow-up, while no change was seen in PCDIR. At 18 months follow-up about 10% of the PCDIR patients and 15% of the PCNHR patients  $\geq 80$  years old resided in a nursing home. About 14% of the general Norwegian population at the same age resided in nursing homes in 2007 [57].
- Mortality: The one year mortality of the total study population was about 10%, which is comparable to the mortality rate in similar patients in studies of post-acute treatment and rehabilitation and the mortality in the general Norwegian population of the same age.
- Cost calculations: The costs of the rehabilitation and the at-home care services were substantially higher in PCNHR compared to in PCDIR. The average total costs per patient of rehabilitation, at-home care services and hospital- and short-term nursing home stays until 18 months follow-up were 1.6 times higher in PCNHR.

### **Implementation considerations**

Older people express that their primary aim of rehabilitation after a disabling event is to return to their own homes and to live there as long as they wish with an optimal independence and quality of life [129,130]. Our study showed that this aim can be met by PCDIR which is a model for rehabilitation of older disabled people in the primary health care. PCDIR was not only more effective but also less expensive compared to PCNHR. Furthermore, our data indicate that PCDIR, if adopted on a broader scale, may reduce substantially the number of older people living in nursing homes. On this background we recommend implementation of the PCDIR model in the municipalities as an important means to regain and maintain independence for older people.

### **Future research**

The results from the present study of the PCDIR model should be re-tested in future controlled

studies. The study design should preferably be of level one, and we would recommend a multi-center RCT, in order to obtain results with higher internal and external validity than in our study. If the barriers to performing a study with this design are too high, new studies with the same design as in our project could also provide data of sufficient quality, if they are performed with stringent adherence to the TREND statement.

However, we are fully aware that evaluating rehabilitation models for older disabled patients is a complex enterprise. The various elements of the services being compared must be described in detail and standardized to the greatest extent possible in order to learn more about the different components. The research is even more complicated by the fact that the single components are interrelated. Experienced rehabilitation researchers emphasize that the most important components to consider include staffing, nature of the rehabilitation, patient characteristics, the care environment, source of reimbursement and the culture of the service [27]. Focusing on these elements will facilitate comparison of different models and their outcomes, and will also strengthen the external validity of the studies.

Home-based rehabilitation(HBR) has become a popular strategy among decision-makers both in Scandinavia and other developed countries in spite of low level evidence only. Therefore, a study where participants were randomized to either PCDIR or HBR would probably give important information for future decisions in this field. Future studies should also address resource issues related to a PCDIR rehabilitation center such as the optimal size of the recruitment population, the number of beds in the unit and the composition and size of the staff.

[11,18,19,21,29,31,37,38,61,63,68,69,75-77,79,85,87,88,94,103,108,109,111,114,115,117,121,127-142][4-8,16,20,30,33-36,50,51,64,91-93,127,143-146]



## Section IV. List of references

### Reference List

1. Christensen K, Doblhammer G, Rau R, Vaupel JW: **Ageing populations: the challenges ahead.** *Lancet* 2009, **374**: 1196-1208.
2. <http://www.ssb.no/aarbok/tab/tab-107.html>
3. <http://www.un.org/popin/data.html>
4. Donald IP, Foy C, Jagger C: **Trends in disability prevalence over 10 years in older people living in Gloucestershire.** *Age Ageing* 2010, **39**: 337-342.
5. Manton KG: **Recent declines in chronic disability in the elderly U.S. population: risk factors and future dynamics.** *Annu Rev Public Health* 2008, **29**: 91-113.
6. Manton KG, Lamb VL, Gu X: **Medicare cost effects of recent U.S. disability trends in the elderly: future implications.** *J Aging Health* 2007, **19**: 359-381.
7. Spillman BC: **Changes in elderly disability rates and the implications for health care utilization and cost.** *Milbank Q* 2004, **82**: 157-194.
8. Parker MG, Thorslund M: **Health trends in the elderly population: getting better and getting worse.** *Gerontologist* 2007, **47**: 150-158.
9. [oecd.org/dataoecd/13/8/38343783.pdf](http://oecd.org/dataoecd/13/8/38343783.pdf)
10. Jagger C, Matthews R, Spiers N, Brayne C, Comas-Herrera A, Robinson T, Lindesay J, Croft P: **Compression Or Expansion Of Disability? Forecasting Future Disability Levels Under Changing Patterns of Diseases.** Final report. University of Leicester; 2006. KF 117 02/06
11. Wells JL, Seabrook JA, Stolee P, Borrie MJ, Knoefel F: **State of the art in geriatric rehabilitation. Part II: clinical challenges.** *Arch Phys Med Rehabil* 2003, **84**: 898-903.
12. Scott IA: **Public hospital bed crisis: too few or too misused?** *Aust Health Rev* 2010, **34**: 317-324.
13. Young J, Forster A, Green J: **An estimate of post-acute intermediate care need in an elderly care department for older people.** *Health Soc Care Community* 2003, **11**: 229-231.
14. The world health report 2008: Primary health care now more than ever.
15. World Health Organization (2001): International Classification of Functioning, Disability and Health. Final Draft. Geneva: WHO

16. Graham S, Cameron I: **Towards a unifying theory of rehabilitation.** *J Rehabil Med* 2011, **43**: 76-77.
17. Stucki G, Cieza A, Melvin J: **The International Classification of Functioning, Disability and Health (ICF): a unifying model for the conceptual description of the rehabilitation strategy.** *J Rehabil Med* 2007, **39**: 279-285.
18. Rauch A, Cieza A, Stucki G: **How to apply the International Classification of Functioning, Disability and Health (ICF) for rehabilitation management in clinical practice.** *Eur J Phys Rehabil Med* 2008, **44**: 329-342.
19. Stucki G, Kostanjsek N, Ustun B, Cieza A: **ICF-based classification and measurement of functioning.** *Eur J Phys Rehabil Med* 2008, **44**: 315-328.
20. Rejeski WJ, Ip EH, Marsh AP, Miller ME, Farmer DF: **Measuring disability in older adults: the International Classification System of Functioning, Disability and Health (ICF) framework.** *Geriatr Gerontol Int* 2008, **8**: 48-54.
21. Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G: **Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care.** *J Gerontol A Biol Sci Med Sci* 2004, **59**: 255-263.
22. Halbert J, Crotty M, Whitehead C, Cameron I, Kurrle S, Graham S *et al.*: **Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome: A systematic review.** *J Rehabil Med* 2007, **39**: 507-512.
23. Norwegian White Paper No 21, "Responsibility and Empowerment" ("Ansvar og Meistring")
24. Massof RW: **A clinically meaningful theory of outcome measures in rehabilitation medicine.** *J Appl Meas* 2010, **11**: 253-270.
25. Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM: **Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials.** *BMJ* 2010, **340**: c1718.
26. Prvu Bettger JA, Stineman MG: **Effectiveness of multidisciplinary rehabilitation services in postacute care: state-of-the-science. A review.** *Arch Phys Med Rehabil* 2007, **88**: 1526-1534.
27. Ward D, Drahota A, Gal D, Severs M, Dean TP: **Care home versus hospital and own home environments for rehabilitation of older people.** *Cochrane Database Syst Rev* 2008, CD003164.
28. Bouman A, van RE, Nelemans P, Kempen GI, Knipschild P: **Effects of intensive home visiting programs for older people with poor health status: a systematic review.** *BMC Health Serv Res* 2008, **8**: 74.
29. Huss A, Stuck AE, Rubenstein LZ, Egger M, Clough-Gorr KM: **Multidimensional preventive home visit programs for community-dwelling older adults: a systematic review and meta-analysis of randomized controlled trials.** *J Gerontol A Biol Sci Med Sci* 2008, **63**: 298-307.
30. Stuck AE, Egger M, Hammer A, Minder CE, Beck JC: **Home visits to prevent nursing home admission and functional decline in elderly people: systematic review and meta-regression analysis.** *JAMA* 2002, **287**: 1022-1028.

31. Ryburn B, Wells Y, Foreman P: **Enabling independence: restorative approaches to home care provision for frail older adults.** *Health Soc Care Community* 2009, **17**: 225-234.
32. Bouman A, van RE, Evers S, Ambergen T, Kempen G, Knipschild P: **Effects on health care use and associated cost of a home visiting program for older people with poor health status: a randomized clinical trial in the Netherlands.** *J Gerontol A Biol Sci Med Sci* 2008, **63**: 291-297.
33. Avlund K, Vass M, Kvist K, Hendriksen C, Keiding N: **Educational intervention toward preventive home visitors reduced functional decline in community-living older women.** *J Clin Epidemiol* 2007, **60**: 954-962.
34. Vass M, Avlund K, Siersma V, Hendriksen C: **A feasible model for prevention of functional decline in older home-dwelling people--the GP role. A municipality-randomized intervention trial.** *Fam Pract* 2009, **26**: 56-64.
35. Vass M, Avlund K, Hendriksen C, Andersen CK, Keiding N: **Preventive home visits to older people in Denmark: methodology of a randomized controlled study.** *Aging Clin Exp Res* 2002, **14**: 509-515.
36. Vass M, Avlund K, Lauridsen J, Hendriksen C: **Feasible model for prevention of functional decline in older people: municipality-randomized, controlled trial.** *J Am Geriatr Soc* 2005, **53**: 563-568.
37. Mallinson TR, Bateman J, Tseng HY, Manheim L, Almagor O, Deutsch A *et al.*: **A comparison of discharge functional status after rehabilitation in skilled nursing, home health, and medical rehabilitation settings for patients after lower-extremity joint replacement surgery.** *Arch Phys Med Rehabil* 2011, **92**: 712-720.
38. Crotty M, Giles LC, Halbert J, Harding J, Miller M: **Home versus day rehabilitation: a randomised controlled trial.** *Age Ageing* 2008, **37**: 628-633.
39. Parker SG, Oliver P, Pennington M, Bond J, Jagger C, Enderby PM *et al.*: **Rehabilitation of older patients: day hospital compared with rehabilitation at home. A randomised controlled trial.** *Health Technol Assess* 2009, **13**: 1-iv.
40. Gitlin LN, Hauck WW, Winter L, Dennis MP, Schulz R: **Effect of an in-home occupational and physical therapy intervention on reducing mortality in functionally vulnerable older people: preliminary findings.** *J Am Geriatr Soc* 2006, **54**: 950-955.
41. Gitlin LN, Hauck WW, Dennis MP, Winter L, Hodgson N, Schinfeld S: **Long-term effect on mortality of a home intervention that reduces functional difficulties in older adults: results from a randomized trial.** *J Am Geriatr Soc* 2009, **57**: 476-481.
42. Melis RJ, van Eijken MI, Teerenstra S, van AT, Parker SG, Borm GF *et al.*: **A randomized study of a multidisciplinary program to intervene on geriatric syndromes in vulnerable older people who live at home (Dutch EASYcare Study).** *J Gerontol A Biol Sci Med Sci* 2008, **63**: 283-290.
43. Stevenson J, Spencer L. *Developing Intermediate Care: a guide for health and social services professionals.* London: King's Fund, 2002.
44. Steiner A. *Intermediate care: a conceptual framework and review of the literature.* London: King's Fund. 1997

45. Griffiths PD, Edwards MH, Forbes A, Harris RL, Ritchie G: **Effectiveness of intermediate care in nursing-led in-patient units.** *Cochrane Database Syst Rev* 2007, CD002214.
46. Shepperd S, Doll H, Broad J, Gladman J, Iliffe S, Langhorne P *et al.*: **Early discharge hospital at home.** *Cochrane Database Syst Rev* 2009, CD000356.
47. Cunliffe AL, Gladman JR, Husbands SL, Miller P, Dewey ME, Harwood RH: **Sooner and healthier: a randomised controlled trial and interview study of an early discharge rehabilitation service for older people.** *Age Ageing* 2004, **33**: 246-252.
48. Fjaertoft H, Indredavik B, Lydersen S: **Stroke unit care combined with early supported discharge: long-term follow-up of a randomized controlled trial.** *Stroke* 2003, **34**: 2687-2691.
49. Fjaertoft H, Rohweder G, Indredavik B: **Stroke unit care combined with early supported discharge improves 5-year outcome: a randomized controlled trial.** *Stroke* 2011, **42**: 1707-1711.
50. Langhorne P, Holmqvist LW: **Early supported discharge after stroke.** *J Rehabil Med* 2007, **39**: 103-108.
51. Donald IP, Jay T, Linsell J, Foy C: **Defining the appropriate use of community hospital beds.** *Br J Gen Pract* 2001, **51**: 95-100.
52. Green J, Young J, Forster A, Mallinder K, Bogle S, Lowson K *et al.*: **Effects of locality based community hospital care on independence in older people needing rehabilitation: randomised controlled trial.** *BMJ* 2005, **331**: 317-322.
53. Young J, Green J, Forster A, Small N, Lowson K, Bogle S *et al.*: **Postacute care for older people in community hospitals: a multicenter randomized, controlled trial.** *J Am Geriatr Soc* 2007, **55**: 1995-2002.
54. Garasen H, Windspoll R, Johnsen R: **Intermediate care at a community hospital as an alternative to prolonged general hospital care for elderly patients: a randomised controlled trial.** *BMC Public Health* 2007, **7**: 68.
55. Garasen H, Windspoll R, Johnsen R: **Long-term patients' outcomes after intermediate care at a community hospital for elderly patients: 12-month follow-up of a randomized controlled trial.** *Scand J Public Health* 2008, **36**: 197-204.
56. Griffiths P, Edwards M, Forbes A, Harris R: **Post-acute intermediate care in nursing-led units: a systematic review of effectiveness.** *Int J Nurs Stud* 2005, **42**: 107-116.
57. Naylor MD, Brooten D, Campbell R, Jacobsen BS, Mezey MD, Pauly MV *et al.*: **Comprehensive discharge planning and home follow-up of hospitalized elders: a randomized clinical trial.** *JAMA* 1999, **281**: 613-620.
58. Shepperd S, Parkes J, McClaren J, Phillips C: **Discharge planning from hospital to home.** *Cochrane Database Syst Rev* 2004, CD000313.
59. Shepperd S, McClaran J, Phillips CO, Lannin NA, Clemson LM, McCluskey A *et al.*: **Discharge planning from hospital to home.** *Cochrane Database Syst Rev* 2010, CD000313.

60. Forster A, Young J: **Community rehabilitation for older people: day hospital or home-based services?** *Age Ageing* 2011, **40**: 2-4.
61. Luk JK, Chan CF: **Rehabilitation outcomes of older patients at 6 months follow-up after discharged from a geriatric day hospital (GDH).** *Arch Gerontol Geriatr* 2011, **52**: 327-330.
62. Boston NK, Boynton PM, Hood S: **An inner city GP unit versus conventional care for elderly patients: prospective comparison of health functioning, use of services and patient satisfaction.** *Fam Pract* 2001, **18**: 141-148.
63. Fleming SA, Blake H, Gladman JR, Hart E, Lymbery M, Dewey ME *et al.*: **A randomised controlled trial of a care home rehabilitation service to reduce long-term institutionalisation for elderly people.** *Age Ageing* 2004, **33**: 384-390.
64. Sonn U: **Longitudinal studies of dependence in daily life activities among elderly persons.** *Scand J Rehabil Med Suppl* 1996, **34**: 1-35.
65. Bathen T, Vardeberg K. Test-retest Reliability of the Sunnaas ADL Index. *Scand J Occup Ther* 2001; **8**:140-7
66. Wekre LL, Vardeberg K, (red.) Lærebok i rehabilitering. Når livet blir annerledes. Fagbokforlaget. 2004. ISBN 82-7674-746-9
67. Claesson L, Svensson E: **Measures of order consistency between paired ordinal data: application to the Functional Independence Measure and Sunnaas index of ADL.** *J Rehabil Med* 2001, **33**: 137-144.
68. Rohde G, Haugeberg G, Mengshoel AM, Moum T, Wahl AK: **Two-year changes in quality of life in elderly patients with low-energy hip fractures. A case-control study.** *BMC Musculoskelet Disord* 2010, **11**: 226.
69. Fjaertoft H, Indredavik B, Johnsen R, Lydersen S: **Acute stroke unit care combined with early supported discharge. Long-term effects on quality of life. A randomized controlled trial.** *Clin Rehabil* 2004, **18**: 580-586.
70. Fugl-Meyer AR, Melin R, Fugl-Meyer KS: **Life satisfaction in 18- to 64-year-old Swedes: in relation to gender, age, partner and immigrant status.** *J Rehabil Med* 2002, **34**: 239-246.
71. Engedal K, Haugen P, Gilje K, Laake P: **Efficacy of short mental tests in the detection of mental impairment in old age.** *Compr Gerontol A* 1988, **2**: 87-93.
72. Bour A, Rasquin S, Boreas A, Limburg M, Verhey F: **How predictive is the MMSE for cognitive performance after stroke?** *J Neurol* 2010, **257**: 630-637.
73. Beloosesky Y, Grinblat J, Epelboym B, Weiss A, Grosman B, Hendel D: **Functional gain of hip fracture patients in different cognitive and functional groups.** *Clin Rehabil* 2002, **16**: 321-328.
74. Huusko TM, Karppi P, Avikainen V, Kautiainen H, Sulkava R: **Randomised, clinically controlled trial of intensive geriatric rehabilitation in patients with hip fracture: subgroup analysis of patients with dementia.** *BMJ* 2000, **321**: 1107-1111.

75. Morghen S, Gentile S, Ricci E, Guerini F, Bellelli G, Trabucchi M: **Rehabilitation of older adults with hip fracture: cognitive function and walking abilities.** *J Am Geriatr Soc* 2011, **59**: 1497-1502.
76. Luk JK, Chiu PK, Chu LW: **Rehabilitation of older Chinese patients with different cognitive functions: how do they differ in outcome?** *Arch Phys Med Rehabil* 2008, **89**: 1714-1719.
77. Young Y, Xiong K, Pruzek RM: **Longitudinal functional recovery after postacute rehabilitation in older hip fracture patients: the role of cognitive impairment and implications for long-term care.** *J Am Med Dir Assoc* 2011, **12**: 431-438.
78. Strand BH, Dalgard OS, Tambs K, Rognerud M: **Measuring the mental health status of the Norwegian population: a comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36).** *Nord J Psychiatry* 2003, **57**: 113-118.
79. Syed HR, Zachrisson HD, Dalgard OS, Dalen I, Ahlberg N: **Concordance between Hopkins Symptom Checklist (HSCL-10) and Pakistan Anxiety and Depression Questionnaire (PADQ), in a rural self-motivated population in Pakistan.** *BMC Psychiatry* 2008, **8**: 59.
80. Des Jarlais DC, Lyles C, Crepaz N: **Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement.** *Am J Public Health* 2004, **94**: 361-366.
81. Armstrong R, Waters E, Moore L, Riggs E, Cuervo LG, Lumbiganon P *et al.*: **Improving the reporting of public health intervention research: advancing TREND and CONSORT.** *J Public Health (Oxf)* 2008, **30**: 103-109.
82. Vickers AJ, Altman DG: **Statistics notes: Analysing controlled trials with baseline and follow up measurements.** *BMJ* 2001, **323**: 1123-1124.
83. Aaraas I, Forde OH, Kristiansen IS, Melbye H: **Do general practitioner hospitals reduce the utilisation of general hospital beds? Evidence from Finnmark county in north Norway.** *J Epidemiol Community Health* 1998, **52**: 243-246.
84. Moll van CE, Hartman E, Yzermans J, Voogt E, Klazinga N, Bindels P: **The first general practitioner hospital in The Netherlands: towards a new form of integrated care?** *Scand J Prim Health Care* 2004, **22**: 38-43.
85. Handoll HH, Cameron ID, Mak JC, Finnegan TP: **Multidisciplinary rehabilitation for older people with hip fractures.** *Cochrane Database Syst Rev* 2009, CD007125.
86. Stott D, Handoll H: **Rehabilitation of older people after hip (proximal femoral) fracture.** *Cochrane Database Syst Rev* 2011, ED000023.
87. Wu CY, Chuang LL, Lin KC, Lee SD, Hong WH: **Responsiveness, minimal detectable change, and minimal clinically important difference of the Nottingham Extended Activities of Daily Living Scale in patients with improved performance after stroke rehabilitation.** *Arch Phys Med Rehabil* 2011, **92**: 1281-1287.
88. Schlote A, Kruger J, Topp H, Wallesch CW: **[Inter-rater reliability of the Barthel Index, the Activity Index, and the Nottingham Extended Activities of Daily Living: The use of ADL instruments in stroke rehabilitation by medical and non medical personnel].** *Rehabilitation (Stuttg)* 2004, **43**: 75-82.

89. Beswick AD, Rees K, Dieppe P, Ayis S, Gooberman-Hill R, Horwood J *et al.*: **Complex interventions to improve physical function and maintain independent living in elderly people: a systematic review and meta-analysis.** *Lancet* 2008, **371**: 725-735.
90. Vidan M, Serra JA, Moreno C, Riquelme G, Ortiz J: **Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: a randomized, controlled trial.** *J Am Geriatr Soc* 2005, **53**: 1476-1482.
91. Netuveli G, Blane D: **Quality of life in older ages.** *Br Med Bull* 2008, **85**: 113-126.
92. Jeste DV, Depp CA, Vahia IV: **Successful cognitive and emotional aging.** *World Psychiatry* 2010, **9**: 78-84.
93. Garatachea N, Molinero O, Martinez-Garcia R, Jimenez-Jimenez R, Gonzalez-Gallego J, Marquez S: **Feelings of well being in elderly people: relationship to physical activity and physical function.** *Arch Gerontol Geriatr* 2009, **48**: 306-312.
94. Kuzuya M, Hasegawa J, Hirakawa Y, Enoki H, Izawa S, Hirose T *et al.*: **Impact of informal care levels on discontinuation of living at home in community-dwelling dependent elderly using various community-based services.** *Arch Gerontol Geriatr* 2011, **52**: 127-132.
95. Statistics Norway <http://www.ssb.no/00/01/20/valgaktuelt/arkiv/art-2007-08-28-01.html>
96. Chen LK, Chen YM, Hwang SJ, Peng LN, Lin MH, Lee WJ *et al.*: **Effectiveness of community hospital-based post-acute care on functional recovery and 12-month mortality in older patients: a prospective cohort study.** *Ann Med* 2010, **42**: 630-636.
97. Statistics Norway [www.ssb.no](http://www.ssb.no), dra@ssb.no
98. Baztan JJ, Galvez CP, Socorro A: **Recovery of functional impairment after acute illness and mortality: one-year follow-up study.** *Gerontology* 2009, **55**: 269-274.
99. Johansen I, Lindbaek M, Stanghelle JK, Brekke M: **Structured community-based inpatient rehabilitation of older patients is better than standard primary health care rehabilitation - an open comparative study.** *Disabil Rehabil* 2012, **34**: 2039-2046.
100. Cameron ID, Schaafsma FG, Wilson S, Baker W, Buckley S: **Outcomes of rehabilitation in older people--functioning and cognition are the most important predictors: an inception cohort study.** *J Rehabil Med* 2012, **44**: 24-30.
101. Poynter L, Kwan J, Sayer AA, Vassallo M: **Does cognitive impairment affect rehabilitation outcome?** *J Am Geriatr Soc* 2011, **59**: 2108-2111.
102. Denti L, Agosti M, Franceschini M: **Outcome predictors of rehabilitation for first stroke in the elderly.** *Eur J Phys Rehabil Med* 2008, **44**: 3-11.
103. HersHKovitz A, Kalandariov Z, Hermush V, Weiss R, Brill S: **Factors affecting short-term rehabilitation outcomes of disabled elderly patients with proximal hip fracture.** *Arch Phys Med Rehabil* 2007, **88**: 916-921.
104. Haentjens P, Lamraski G, Boonen S: **Costs and consequences of hip fracture occurrence in old age: an economic perspective.** *Disabil Rehabil* 2005, **27**: 1129-1141.

105. Statistics Norway  
[http://statbank.ssb.no/statistikkbanken/Default\\_FR.asp?PXSid=0&nvl=true&PLanguage=0&tlside=selectvarval/define.asp&Tabellid=05375](http://statbank.ssb.no/statistikkbanken/Default_FR.asp?PXSid=0&nvl=true&PLanguage=0&tlside=selectvarval/define.asp&Tabellid=05375)
106. Aaraas I, Sorasdekkkan H, Kristiansen IS: **Are general practitioner hospitals cost-saving? Evidence from a rural area of Norway.** *Fam Pract* 1997, **14**: 397-402.
107. Hakkaart-van RL, Moll van Charante EP, Bindels PJ, Yzermans CJ, Rutten FF: **A cost study of a general practitioner hospital in the Netherlands.** *Eur J Gen Pract* 2004, **10**: 45-49.
108. Miller P, Gladman JR, Cunliffe AL, Husbands SL, Dewey ME, Harwood RH: **Economic analysis of an early discharge rehabilitation service for older people.** *Age Ageing* 2005, **34**: 274-280.
109. O'Reilly J, Lowson K, Green J, Young JB, Forster A: **Post-acute care for older people in community hospitals--a cost-effectiveness analysis within a multi-centre randomised controlled trial.** *Age Ageing* 2008, **37**: 513-520.
110. Garasen H, Magnussen J, Windspoll R, Johnsen R: **[Elderly patients in hospital or in an intermediate nursing home department--cost analysis].** *Tidsskr Nor Laegeforen* 2008, **128**: 283-285.
111. Nurmi I, Narinen A, Luthje P, Tanninen S: **Cost analysis of hip fracture treatment among the elderly for the public health services: a 1-year prospective study in 106 consecutive patients.** *Arch Orthop Trauma Surg* 2003, **123**: 551-554.
112. Kramer AM, Steiner JF, Schlenker RE, Eilertsen TB, Hrincevich CA, Tropea DA *et al.*: **Outcomes and costs after hip fracture and stroke. A comparison of rehabilitation settings.** *JAMA* 1997, **277**: 396-404.
113. Fjaertoft H. Extended stroke unit service and early supported discharge. Short and long-term effects. PhD Theses. University of Trondheim, Norway, 2005:205.
114. Cameron ID, Kurrle SE: **1: Rehabilitation and older people.** *Med J Aust* 2002, **177**: 387-391.
115. Wells JL, Seabrook JA, Stolee P, Borrie MJ, Knoefel F: **State of the art in geriatric rehabilitation. Part I: review of frailty and comprehensive geriatric assessment.** *Arch Phys Med Rehabil* 2003, **84**: 890-897.
116. Sangha H, Lipson D, Foley N, Salter K, Bhogal S, Pohani G *et al.*: **A comparison of the Barthel Index and the Functional Independence Measure as outcome measures in stroke rehabilitation: patterns of disability scale usage in clinical trials.** *Int J Rehabil Res* 2005, **28**: 135-139.
117. Coleman SA, Cunningham CJ, Walsh JB, Coakley D, Harbison J, Casey M *et al.*: **Outcomes among older people in a post-acute inpatient rehabilitation unit.** *Disabil Rehabil* 2012, **34**: 1333-1338.
118. Mehta SP, Roy JS: **Systematic review of home physiotherapy after hip fracture surgery.** *J Rehabil Med* 2011, **43**: 477-480.
119. Handoll HH, Sherrington C, Mak JC: **Interventions for improving mobility after hip fracture surgery in adults.** *Cochrane Database Syst Rev* 2011, CD001704.



120. Jette DU, Warren RL, Wirtalla C: **The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities.** *Arch Phys Med Rehabil* 2005, **86**: 373-379.
121. Ryan T, Enderby P, Rigby AS: **A randomized controlled trial to evaluate intensity of community-based rehabilitation provision following stroke or hip fracture in old age.** *Clin Rehabil* 2006, **20**: 123-131.
122. Forster A, Young J: **Day hospital and stroke patients.** *Int Disabil Stud* 1989, **11**: 181-183.
123. Cameron I, Crotty M, Currie C, Finnegan T, Gillespie L, Gillespie W *et al.*: **Geriatric rehabilitation following fractures in older people: a systematic review.** *Health Technol Assess* 2000, **4**: i-111.
124. Kuisma R: **A randomized, controlled comparison of home versus institutional rehabilitation of patients with hip fracture.** *Clin Rehabil* 2002, **16**: 553-561.
125. Laver K, Ratcliffe J, George S, Lester L, Walker R, Burgess L *et al.*: **Early rehabilitation management after stroke: what do stroke patients prefer?** *J Rehabil Med* 2011, **43**: 354-358.
126. Lauridsen UB, de la Cour BB, Gottschalck L, Svensson BH: **Intensive physical therapy after hip fracture. A randomised clinical trial.** *Dan Med Bull* 2002, **49**: 70-72.
127. Esselman PC: **Inpatient rehabilitation outcome trends: implications for the future.** *JAMA* 2004, **292**: 1746-1748.
128. Ottenbacher KJ, Smith PM, Illig SB, Linn RT, Ostir GV, Granger CV: **Trends in length of stay, living setting, functional outcome, and mortality following medical rehabilitation.** *JAMA* 2004, **292**: 1687-1695.
129. Gillsjo C, Schwartz-Barcott D, von P, I: **Home: the place the older adult cannot imagine living without.** *BMC Geriatr* 2011, **11**: 10.
130. Fange A, Ivanoff SD: **The home is the hub of health in very old age: Findings from the ENABLE-AGE Project.** *Arch Gerontol Geriatr* 2009, **48**: 340-345.
131. Stewart DG, Phillips EM, Bodenheimer CF, Cifu DX: **Geriatric rehabilitation. 2. Physiatric approach to the older adult.** *Arch Phys Med Rehabil* 2004, **85**: S7-11.
132. Fjaertoft H, Indredavik B, Magnussen J, Johnsen R: **Early supported discharge for stroke patients improves clinical outcome. Does it also reduce use of health services and costs? One-year follow-up of a randomized controlled trial.** *Cerebrovasc Dis* 2005, **19**: 376-383.
133. Werngren-Elgstrom M, Carlsson G, Iwarsson S: **A 10-year follow-up study on subjective well-being and relationships to person-environment (P-E) fit and activity of daily living (ADL) dependence of older Swedish adults.** *Arch Gerontol Geriatr* 2009, **49**: e16-e22.
134. Sahlen KG, Lofgren C, Mari HB, Lindholm L: **Preventive home visits to older people are cost-effective.** *Scand J Public Health* 2008, **36**: 265-271.
135. Ellison C, White A, Chapman L: **Avoiding institutional outcomes for older adults living with disability: the use of community-based aged care supports.** *J Intellect Dev Disabil* 2011, **36**: 175-183.

136. Pettersen R, Wyller TB: **[Rehabilitation integrated in acute medical treatment]**. *Tidsskr Nor Laegeforen* 2007, **127**: 600-603.
137. Parker SG, Oliver P, Pennington M, Bond J, Jagger C, Enderby P *et al.*: **Rehabilitation of older patients: day hospital compared with rehabilitation at home. Clinical outcomes.** *Age Ageing* 2011, **40**: 557-562.
138. Crotty M, Whitehead CH, Gray S, Finucane PM: **Early discharge and home rehabilitation after hip fracture achieves functional improvements: a randomized controlled trial.** *Clin Rehabil* 2002, **16**: 406-413.
139. Lohmann S, Decker J, Muller M, Strobl R, Grill E: **The ICF forms a useful framework for classifying individual patient goals in post-acute rehabilitation.** *J Rehabil Med* 2011, **43**: 151-155.
140. Huusko TM, Karppi P, Avikainen V, Kautiainen H, Sulkava R: **Intensive geriatric rehabilitation of hip fracture patients: a randomized, controlled trial.** *Acta Orthop Scand* 2002, **73**: 425-431.
141. Kehusmaa S, Autti-Ramo I, Valaste M, Hinkka K, Rissanen P: **Economic evaluation of a geriatric rehabilitation programme: a randomized controlled trial.** *J Rehabil Med* 2010, **42**: 949-955.
142. Muir SW, Yohannes AM: **The impact of cognitive impairment on rehabilitation outcomes in elderly patients admitted with a femoral neck fracture: a systematic review.** *J Geriatr Phys Ther* 2009, **32**: 24-32.
143. Evans RL, Connis RT, Haselkorn JK: **Hospital-based rehabilitative care versus outpatient services: effect on functioning and health status.** *Disabil Rehabil* 1998, **20**: 298-307.
144. Rubenstein LZ, Josephson KR, Wieland GD, English PA, Sayre JA, Kane RL: **Effectiveness of a geriatric evaluation unit. A randomized clinical trial.** *N Engl J Med* 1984, **311**: 1664-1670.
145. Garasen H, Hendriksen C: **Health care for the elderly--perspectives in relation to implementation of results from intervention studies in Norway and Denmark.** *Scand J Public Health* 2009, **37**: 223-226.
146. Beaupre LA, Cinats JG, Jones CA, Scharfenberger AV, William CJ, Senthilselvan A *et al.*: **Does functional recovery in elderly hip fracture patients differ between patients admitted from long-term care and the community?** *J Gerontol A Biol Sci Med Sci* 2007, **62**: 1127-1133.

# Appendix





Sunnaas sykehus HF

# SUNNAAS ADL INDEX

NAME:

D.o.B:

DIAGNOSIS

INSTITUTION:

OCC.THERAPIST:

## SCORING:

- 3 = Can manage alone, and does it  
2 = Can manage alone, and does it, under special conditions  
1 = Needs some help or motivation from another person. Alt. can manage alone, but does not do it.  
0 = Can not manage

INDEPENDENT

DEPENDENT

## SEE MANUAL FOR SCORING

Note! Separate scoring key for spinal cord injured (SCI) for items 2 and 4..Item 2 reads for SCI "bladder-management" and item 4 reads "bowelmanagement"

| Date:                     |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
|---------------------------|---|---|---|---|--|---|---|---|---|--|---|---|---|---|--|--|
|                           | 0 | 1 | 2 | 3 |  | 0 | 1 | 2 | 3 |  | 0 | 1 | 2 | 3 |  |  |
| 1.EATING                  |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 2.CONTINENCE              |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 3.INDOOR MOBILITY         |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 4.TOILET-MANAGEMENT       |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 5.TRANSFER                |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 6.DRESSING AND UNDRESSING |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 7.GROOMING                |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 8.COOKING                 |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 9.BATH /SHOWER            |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 10.HOUSEWORK              |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 11.OUTDOOR MOBILITY       |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| 12.COMMUNICATION          |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |
| SUM:                      |   |   |   |   |  |   |   |   |   |  |   |   |   |   |  |  |

## COMMENTS:

F:\IERGORAPPI\Sunnaas ADL-index\Engelsk oversettelse\ADL skjema eng.doc

Postadresse:  
1450 Nesoddtangen

Telefon: 66 96 90 00

Telefaks: 66 91 25 76

Besøksadresse: Bjørnemyrveien  
11

E-post: firmapost@sunnaas.no

Giro: 6004 06 57048

Foretaksnr.: 883 971 752



**LSC, Umeaa Life Satisfaction Checklist** [1], is a simple and validated questionnaire, testing life satisfaction. We chose two of the questions:

1. LSCa: How satisfied are you with your life in general? ☐

2. LSCb: How satisfied are you with your ability to manage your self-care? ☐

The scores are 1-3=dissatisfied and 4-6=satisfied:

1. Very dissatisfied
2. Dissatisfied
3. Somewhat dissatisfied
4. Somewhat satisfied
5. Satisfied
6. Very satisfied

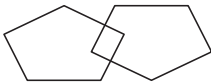
1. Fugl-Meyer AR, Melin R, Fugl-Meyer KS. Life satisfaction in 18- to 64-year-old Swedes: In relation to gender, age, partner and immigrant status. J Rehabil Med 2002; 34: 239-46.

## Mini-Mental State Examination (MMSE)

Patient's Name: \_\_\_\_\_

Date: \_\_\_\_\_

***Instructions:*** Ask the questions in the order listed. Score one point for each correct response within each question or activity.

| Maximum Score | Patient's Score | Questions   |
|---------------|-----------------|---|
| 5             |                 | "What is the year? Season? Date? Day of the week? Month?"   |
| 5             |                 | "Where are we now: State? County? Town/city? Hospital? Floor?"  |
| 3             |                 | The examiner names three unrelated objects clearly and slowly, then asks the patient to name all three of them. The patient's response is used for scoring. The examiner repeats them until patient learns all of them, if possible. Number of trials: _____                |
| 5             |                 | "I would like you to count backward from 100 by sevens." (93, 86, 79, 72, 65, ...) Stop after five answers.<br>Alternative: "Spell WORLD backwards." (D-L-R-O-W)  |
| 3             |                 | "Earlier I told you the names of three things. Can you tell me what those were?"  |
| 2             |                 | Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.   |
| 1             |                 | "Repeat the phrase: 'No ifs, ands, or buts.'"   |
| 3             |                 | "Take the paper in your right hand, fold it in half, and put it on the floor." (The examiner gives the patient a piece of blank paper.)   |
| 1             |                 | "Please read this and do what it says." (Written instruction is "Close your eyes.")   |
| 1             |                 | "Make up and write a sentence about anything." (This sentence must contain a noun and a verb.)  |
| 1             |                 | "Please copy this picture." (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.)<br> |
| 30            |                 | TOTAL   |

(Adapted from Rovner & Folstein, 1987)

## **Instructions for administration and scoring of the MMSE**

### **Orientation (10 points):**

- Ask for the date. Then specifically ask for parts omitted (e.g., "Can you also tell me what season it is?"). One point for each correct answer.
- Ask in turn, "Can you tell me the name of this hospital (town, county, etc.)?" One point for each correct answer.

### **Registration (3 points):**

- Say the names of three unrelated objects clearly and slowly, allowing approximately one second for each. After you have said all three, ask the patient to repeat them. The number of objects the patient names correctly upon the first repetition determines the score (0-3). If the patient does not repeat all three objects the first time, continue saying the names until the patient is able to repeat all three items, up to six trials. Record the number of trials it takes for the patient to learn the words. If the patient does not eventually learn all three, recall cannot be meaningfully tested.
- After completing this task, tell the patient, "Try to remember the words, as I will ask for them in a little while."

### **Attention and Calculation (5 points):**

- Ask the patient to begin with 100 and count backward by sevens. Stop after five subtractions (93, 86, 79, 72, 65). Score the total number of correct answers.
- If the patient cannot or will not perform the subtraction task, ask the patient to spell the word "world" backwards. The score is the number of letters in correct order (e.g., dlrow=5, dlrow=3).

### **Recall (3 points):**

- Ask the patient if he or she can recall the three words you previously asked him or her to remember. Score the total number of correct answers (0-3).

### **Language and Praxis (9 points):**

- Naming: Show the patient a wrist watch and ask the patient what it is. Repeat with a pencil. Score one point for each correct naming (0-2).
- Repetition: Ask the patient to repeat the sentence after you ("No ifs, ands, or buts."). Allow only one trial. Score 0 or 1.
- 3-Stage Command: Give the patient a piece of blank paper and say, "Take this paper in your right hand, fold it in half, and put it on the floor." Score one point for each part of the command correctly executed.
- Reading: On a blank piece of paper print the sentence, "Close your eyes," in letters large enough for the patient to see clearly. Ask the patient to read the sentence and do what it says. Score one point only if the patient actually closes his or her eyes. This is not a test of memory, so you may prompt the patient to "do what it says" after the patient reads the sentence.
- Writing: Give the patient a blank piece of paper and ask him or her to write a sentence for you. Do not dictate a sentence; it should be written spontaneously. The sentence must contain a subject and a verb and make sense. Correct grammar and punctuation are not necessary.
- Copying: Show the patient the picture of two intersecting pentagons and ask the patient to copy the figure exactly as it is. All ten angles must be present and two must intersect to score one point. Ignore tremor and rotation.

(Folstein, Folstein & McHugh, 1975)



### **Interpretation of the MMSE**

| Method        | Score | Interpretation                               |
|---------------|-------|--|
| Single Cutoff | <24   | Abnormal                                     |
| Range         | <21   | Increased odds of dementia                   |
|               | >25   | Decreased odds of dementia                   |
| Education     | 21    | Abnormal for 8 <sup>th</sup> grade education |
|               | <23   | Abnormal for high school education           |
|               | <24   | Abnormal for college education               |
| Severity      | 24-30 | No cognitive impairment                      |
|               | 18-23 | Mild cognitive impairment                    |
|               | 0-17  | Severe cognitive impairment                  |

### **Sources:**

- Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the mini-mental state examination by age and educational level. *JAMA*. 1993;269(18):2386-2391.
- Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12:189-198.
- Rovner BW, Folstein MF. Mini-mental state exam in clinical practice. *Hosp Pract*. 1987;22(1A):99, 103, 106, 110.
- Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. *J Am Geriatr Soc*. 1992;40(9):922-935.

### **Symptom Checklist 10 (SCL-10)**

| Experience during the previous week              | Not at all=1 | Now and then=2 | Often =3 | Extremely =4 |
|--|--------------|----------------|----------|--------------|
| 1.Suddenly scared for no reason                  |              |                |          |              |
| 2.Feeling fearful                                |              |                |          |              |
| 3.Faintness, dizziness, or weakness              |              |                |          |              |
| 4.Feeling tense or keyed up                      |              |                |          |              |
| 5.Blaming yourself for things                    |              |                |          |              |
| 6.Difficulty in falling asleep or staying asleep |              |                |          |              |
| 7.Feeling blue                                   |              |                |          |              |
| 8.Feeling of worthlessness                       |              |                |          |              |
| 9.Feeling everything is an effort                |              |                |          |              |
| 10.Feeling hopeless about future                 |              |                |          |              |
| SCORE  |              |                |          |              |
| TOTAL score                                      |              |                |          |              |

Out of the 10- items described above, the first 4-items were related to anxiety and the remaining to depression. Each item was rated on a scale from 1 (not at all) to 4 (extremely).

Total score is sum of scores divided by 10.

Ref.

1. Syed HR, Zachrisson HD, Dalgard OS, Dalen I, Ahlberg N. Concordance between Hopkins Symptom Checklist (HSCL-10) and Pakistan Anxiety and Depression Questionnaire (PADQ), in a rural self-motivated population in Pakistan. *BMC Psychiatry* 2008, **8**:59 doi:10.1186/1471-244X-8-59
2. Strand BH, Dalgard OS, Tambs K, Rognerud M. Measuring the mental health status of the Norwegian population: A comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). *Nord J Psychiatry* 2003;57:113-18.

## **Section V. The Study papers**







## SHORT COMMUNICATION

# EFFECTIVE REHABILITATION OF OLDER PEOPLE IN A DISTRICT REHABILITATION CENTRE

Inger Johansen, MD<sup>1</sup>, Morten Lindbaek, MD, PhD<sup>1</sup>, Johan K. Stanghelle, MD, PhD<sup>2</sup> and Mette Brekke, MD, PhD<sup>1</sup>

From the <sup>1</sup>Department of General Practice/General Practice Research Unit, Institute of Health and Society and <sup>2</sup>Sunnaas Rehabilitation Hospital, and Medical Faculty, University of Oslo, Oslo, Norway

**Objective:** To assess the outcome of rehabilitation of older patients in a district rehabilitation centre.

**Design:** Prospective observational study.

**Patients:** A total of 202 patients aged  $\geq 65$  years rehabilitated at a Norwegian district inpatient rehabilitation centre, referred from district hospital, nursing homes or their own homes. Diagnoses were: stroke, arthrosis, hip fracture and other chronic diseases.

**Methods:** Admission: according to rehabilitation potential. Treatment: multidisciplinary team including an experienced general practitioner. Primary outcome measure: Sunnaas Activities of Daily Living (ADL) Index (SI). Secondary outcome measure: Umea Life Satisfaction Checklist (LSC). Cognitive (Mini-Mental State Examination (MMSE)), emotional (Symptom Check List-10) and marital status, residence, length of stay and hours/week private and home care services were recorded.

**Results:** SI increased significantly during the mean 3.1 weeks stay (mean 4.2, 95% confidence interval 3.5, 4.8),  $p < 0.001$ ), persisting after 3 months. Eighty-four percent of patients scored satisfied according to LSC after rehabilitation. SI at discharge (adjusted for SI at admission) was predicted by MMSE and type of residence. Seventy-four percent of the patients needed home care services  $< 3$  h/week, at discharge and 3 months later.

**Conclusion:** Significant and persisting improvements in activities of daily living may be achieved by rehabilitation of older patients with stroke, arthrosis, hip fracture and other chronic diseases in a district inpatient rehabilitation centre with co-ordinated and multi-disciplinary rehabilitation.

**Key words:** aged; aged over 80; activities of daily living; rehabilitation; hospital; district.

J Rehabil Med 2011; 43: 461–464

**Correspondence address:** Inger Johansen, Department of General Practice/General Practice Research Unit, Institute of Health and Society, University of Oslo, NO-318 Oslo, Norway.  
E-mail: inger.johansen@medisin.uio.no

Submitted June 25, 2010; accepted January 19, 2011

## INTRODUCTION

The number and proportion of older people in the population will increase until 2030, in industrialized as well as in develop-

ing countries, contributing to a substantial growth in need for care (1). Shorter hospital stays mean that more older people are discharged with disabilities, imposing increased demands on district rehabilitation capacities (2). District rehabilitation services differ in terms of organization and location, and criteria for admission as well as the rehabilitation process are applied in various ways. A successful outcome requires rehabilitation potential, defined as the physiological and psychological possibilities of the patient to restore, keep or develop the best possible level of function and quality of life (2). Co-ordinated multi-disciplinary rehabilitation provides better functional gain and reduces the need for beds in nursing homes for geriatric patients (3), patients with stroke (4) and hip fracture (5). Unfortunately, however, there is insufficient evidence to assess the importance of rehabilitation environments, such as hospital, care home, and patient's own home, on the outcome of rehabilitation (6). Due to the increased demands on district rehabilitation capacities, we therefore urgently need more information about the optimal location and content of rehabilitation of older people in primary healthcare.

The main aim of the present study was to assess the outcome of rehabilitation of elderly patients in a district rehabilitation centre with a multi-disciplinary primary healthcare team offering structured rehabilitation. A further aim was to study life satisfaction, and how rehabilitation outcome and level of care after discharge were influenced by patient characteristics and by mental and emotional status.

## MATERIAL AND METHODS

### *Setting and content of the rehabilitation process*

Participants were patients who were admitted to the geographically detached district rehabilitation centre in Larvik, Norway, a mixed urban and rural community with 40,000 inhabitants. The centre has 16 beds and rehabilitates patients over 18 years of age, with physical and/or minor cognitive disabilities. Patients are referred from hospitals, nursing homes or their own homes and admitted if they are considered to have a rehabilitation potential. This decision is made by a team working at the centre, which includes an experienced general practitioner (GP), a nurse and an occupational or physical therapist. Rehabilitation potential means a certain level of activities of daily living (ADL), cognitive, emotional and physical function, as well as motivation. The centre defines rehabilitation as: time-limited, planned processes, with clear aims and means, where multi-disciplinary teams give assistance to the patient's own work to be as independent as possible, according to his

or her own wishes (2). The aims of the rehabilitation are defined on admission by the patient and the team together, and to return home is of highest priority. The aims are re-evaluated within a bio-psycho-social framework at weekly meetings of the multi-disciplinary team. There is close collaboration between the patient, the team, the patient's private network and the primary healthcare. Training is focused on physical function and ADL, individually or in groups. Home visits are made when the patient is capable, both as daytime visits and overnight stays. Discharge reports are sent to the patient's GP, and to the referring and other relevant wards.

Our main hypothesis was that elderly patients rehabilitated in the district rehabilitation centre would significantly improve their ADL-function from admission to discharge, and that the improvement would persist at 3 months' follow-up.

### Patients

Patients were recruited from June 2006 to October 2007. Inclusion criteria were both genders, age  $\geq 65$  years, and diagnoses stroke, arthritis, hip fracture and "others" (disability due to aging, long hospitalization or chronic diseases). A total of 363 patients were referred to the rehabilitation centre during the study period. Forty-seven patients were not admitted due to lack of rehabilitation potential. Of the 316 admitted patients 114 were not included due to age  $< 65$  years ( $n=33$ ), other than inclusion diagnoses ( $n=22$ ), 2 weeks planned group stays ( $n=40$ ), and absence of the project leader ( $n=19$ ). All the 202 eligible patients gave informed consent to participate in the study at entry. Ninety-one patients were admitted directly from home and 107 from the district general hospital (data missing for 4 patients).

### Outcome measures

Outcome measures were chosen to cover the 6 categories of the International Classification of Functioning, Disability and Health (ICF) (7), as follows:

The *Summaas ADL Index (SI)* (8) measures 12 ADL and fits "activities" into the ICF. Each activity has a score from 0 to 3, where 0 = totally dependent, and 3 = independent. Scores  $< 12$  usually indicate a low rehabilitation potential. SI was the primary outcome measure and registered at admission, discharge and 3 months after discharge. The SI scores of the study patients were at a level where a 20% increase means a change from needing help to being independent in 2–4 ADL situations. Based on this, and on clinical experience, a 20% improvement in SI was judged to be clinically significant. The inter-item consistency between the more frequently used Functional Independence Measure (FIM) and SI is high for many items, but differences are also identified (9). We consider SI sufficient for describing the primary aim of the study. SI is simple and easy to interpret, which is important in primary healthcare.

The *Umea Life Satisfaction Checklist (LSC)* (10) is a simple and validated questionnaire, testing life satisfaction. We chose two of the questions: LSC-a: How satisfied are you with your life in general? LSC-b: How satisfied are you with your ability to manage your self-care? The scores are 1–3 = not satisfied and 4–6 = satisfied. LSC covers "participation" in ICF, and was both a secondary outcome measure and a possible predictor of outcome. It was registered at discharge and 3 months later.

The *Mini-Mental State Examination (MMSE)* (11) measures cognitive function and covers "body functions" and "structures" in the ICF. Scores are from 0 to 30. Values  $< 22$  indicate severe cognitive problems (12). MMSE was a possible predictor measure and was recorded 2 weeks after admission to exclude incidental confusion at entrance.

The *Symptom Check List-10 (SCL-10)* (13) is a questionnaire mapping emotional health during the last week, particularly anxiety and depression. SCL-10 comprises ten questions with scores from 1 to 4. The final score is the total score sum divided by ten. Scores  $> 1.85$  indicate severe emotional problems. SCL-10 covers "personal factors", "body functions" and "structures" in ICF. It was included as a possible predictor of outcome and recorded 2 weeks after admission to avoid possible emotional instability at entrance.

A score for home care services and informal care from relatives, which fits environmental factors in ICF, was recorded at discharge and 3 months later. The care scores were: 1: 0 h/week, 2: 1–2 h/week, 3: 3–5 h/week, 4: 6–8 h/week, and 5:  $\geq 9$  h/week.

Age, gender, type of residence, marital status, length of stay and diagnosis were also recorded.

### Statistics

With a 20% increase in SI judged to be clinically significant, power calculation estimated a need for including 200 patients based on a beta of 0.80 and an alpha  $< 0.05$ . Data were analysed in SPSS version 16.0 for Windows. Two groups of continuous, symmetrically distributed variables were compared by *t*-tests, and several groups by one-way ANOVA (*post hoc* test if  $p < 0.05$ ). Asymmetrically continuous variables were compared by Mann-Whitney-Wilcoxon test. Correlations between continuous variables were analysed by Pearson's (symmetrical distribution) or Spearman's (asymmetrical distribution) correlation coefficient. Categorical variables were compared by Pearson's  $\chi^2$  test. Univariate regression analysis was used to explore predictors of outcome. Statistically significant predictors were analysed in multiple linear regression analysis.

### Ethics

The study was approved by the Regional Ethics Committee for Medical Research and by the Norwegian Social Science Data Services.

## RESULTS

Thirteen of the 202 patients died during the first 3 months after rehabilitation. Two patients were excluded due to serious medical complications.

Table I. Patient characteristics, diagnoses, length of stay, cognitive and emotional status

|                                      | Total       | Men        | Women         |
|--------------------------------------|-------------|------------|---------------|
| Number of patients, <i>n</i> (%)     | 202         | 59 (29)    | 143 (71)      |
| Age, years, mean (SD)                | 80.7 (6.5)  | 78.8 (5.9) | 81.4 (6.6)    |
| [min–max]                            | [65–96]     | [65–95]    | [65–96]*      |
| Residence, <i>n</i> (%)              |             |            |               |
| Own                                  | 168 (83)    | 50 (85)    | 118 (83)      |
| Care-flat                            | 34 (17)     | 9 (15)     | 25 (17)       |
| Marital status, <i>n</i> (%)         |             |            |               |
| Married                              | 71 (35)     | 35 (59)    | 36 (25%)      |
| Alone                                | 131 (65)    | 24 (41%)   | 107 (75%)**   |
| Diagnoses, <i>n</i> (%) <sup>a</sup> |             |            |               |
| Stroke                               | 34 (17)     | 19 (33)    | 15 (11)***    |
| Arthrosis                            | 23 (11)     | 4 (7)      | 19 (13)       |
| Fracture                             | 82 (41)     | 17 (29)    | 65 (46)***    |
| Other                                | 61 (30)     | 18 (31)    | (30)          |
| Stay, weeks, mean (SD)               | 3.1 (1.6)   | 3.8 (2.4)  | 2.9 (1.1)**** |
| [CI] <sup>b</sup>                    | [2.9–3.3]   |            |               |
| MMSE, mean (SD)                      | 25.0 (4.0)  | 24.3 (4.6) | 25.2 (3.7)    |
| [CI] <sup>a</sup>                    | [24.4–25.5] |            |               |
| SCL-10, mean (SD)                    | 1.4 (0.3)   | 1.3 (0.3)  | 1.4 (0.4)     |
| [CI] <sup>b</sup>                    | [1.3–1.4]   |            |               |

\* $p=0.007$  (independent samples *t*-test).

\*\* $p<0.001$  (Pearson's  $\chi^2$ ).

\*\*\* $p=0.001$  (Pearson's  $\chi^2$ ).

\*\*\*\* $p<0.001$  (independent samples *t*-test).

<sup>a</sup> $n=200$ .

<sup>b</sup> $n=201$ .

MMSE: Mini-Mental State Examination; SCL-10: Symptom Check List-10; SD: standard deviation.



Table II. Ability to perform activities of daily living (ADL) and Life satisfaction at admission, discharge and after 3 months in a community rehabilitation centre

|                               | Admission<br>n=201 | Discharge<br>n=201 | 3 months<br>after discharge<br>n=187 |
|-------------------------------|--------------------|--------------------|--------------------------------------|
| SI, mean                      | 23.3               | 27.5*              | 28.1*                                |
| (95% CI)                      | (22.3–24.4)        | (26.8–28.3)        | (27.2–28.9)                          |
| LSC-a, mean (95% CI)          |                    | 4.4 (4.2–4.6)      | 4.3** (4.1–4.4)                      |
| Satisfied, n (%) <sup>a</sup> |                    | 168 (84)           | 147 (79)                             |
| LSC-b, mean (95% CI)          |                    | 4.2 (4.0–4.3)      | 4.3 (4.1–4.4)                        |
| Satisfied, n (%) <sup>a</sup> |                    | 154 (77)           | 149 (80)                             |

\* $p < 0.001$  (paired samples *t*-test) compared with at entrance.

\*\* $p = 0.03$  (95% CI of the difference (0.01, 0.24)) (paired samples *t*-test) compared with at discharge.

<sup>a</sup>Score 4–6.

SI: Sunnaas ADL Index; LSC-a: Umea Life Satisfaction Checklist, satisfaction with life in general; LSC-b: Umea Life Satisfaction Checklist, satisfaction with ability to self-care 95% CI: confidence interval.

Baseline patient characteristics are shown in Table I. The women were older than the men, more frequently lived alone and stayed in the institution for a shorter period of time.

#### Changes in ADL function

SI improved significantly from admission to discharge, by 4.2 points, 95% CI (3.5, 4.8), and the improvement persisted 3 months later (Table II). Improvement was shown in all 12 activities tested, with the largest increase in mobility-related activities. Patients with stroke and fracture improved their SI by 5.1 and 4.7 points, respectively, while patients with arthrosis and other diagnoses improved by 2.8 points. Length of stay was correspondingly longer for patients with stroke and fracture, at 4.0 and 3.3 weeks, respectively, compared with 2.8 and 2.5 weeks for patients with arthrosis and other diagnoses.

#### Life satisfaction

Eighty-four percent of the patients were satisfied with life in general (LSC-a), and 77% were satisfied with the ability to self-care (LSC-b) at discharge, vs 79% and 80% 3 months later (Table II). LSC-a did not correlate with improvement in SI, but LSC-b correlated positively. LSC-a and LSC-b did not correlate with cognitive status (MMSE), but were negatively correlated with emotional score (SCL-10).

Table III. Multiple linear regression analysis, with ability to perform activities of daily living at discharge (measured by SI) as dependent variable

| Variable                  | Unstandardized<br>coefficient B | p      | 95% CI for B |
|---------------------------|---------------------------------|--------|--------------|
| Constant                  | 8.76                            |        |              |
| Gender                    | -0.69                           | 0.19   | -1.72–0.34   |
| Age                       | 0.03                            | 0.39   | -0.04–0.11   |
| Cognitive status (MMSE)   | 0.15                            | 0.02   | 0.03–0.28    |
| Residence (own- vs care-) | 1.82                            | 0.005  | 0.56–3.08    |
| SI at entrance            | 0.52                            | <0.001 | 0.45–0.58    |

SI: Sunnaas ADL Index; 95% CI: 95% confidence interval; MMSE: Mini-Mental State Examination.

#### Level of care

At discharge, 74% of the patients received less than 3 h/week home care services, and 7% received more than 6 h. This remained stable during the 3-month observation period. At discharge the patients received significantly more home care services than informal care from relatives. At 3 months, there were no differences.

#### Predictors for SI at discharge

SI at discharge, adjusted for SI at admission, was independent of gender, age, life satisfaction, emotional and marital status, diagnoses and duration of stay, but was predicted by cognitive and residential status (Table III).

#### Predictors for level of care

Level of home care services at discharge was independent of gender, age, residential status, diagnosis and life satisfaction in general, but was predicted by satisfaction with ability to self-care, cognitive, emotional and marital status (Table IV).

The 15 patients who died or were excluded did not differ from the 187 remaining patients regarding improvement in SI, SI at baseline or LSC scores.

## DISCUSSION

This Norwegian study demonstrates that significant and persisting gain in ADL may be achieved by rehabilitation of older patients with stroke, arthrosis, hip fracture and other chronic diseases in a primary healthcare rehabilitation centre with co-ordinated and multi-disciplinary rehabilitation.

LSC-a refers mainly to existential values. It is therefore reasonable to assume that the answers were not influenced by the improvement in ADL-function. The amount of home care services was equal to care from relatives at 3 months follow-up, indicating that they took their share of care for older people. The level of home care services, but not the level of SI, was associated with poorer emotional status, living alone and dissatisfaction with ability in self-care, indicating that need for home care services is not only a result of ADL-function, but is also influenced by “softer” values. The ICF (7) enables a bio-psycho-social description of the patients to be made, and

Table IV. Multiple linear regression analysis, with public care at discharge as dependent variable

| Variable       | Unstandardized<br>coefficient B | p      | 95% CI for B   |
|----------------|---------------------------------|--------|----------------|
| Constant       | 3.53                            |        |                |
| Gender         | 0.15                            | 0.28   | -0.13 to 0.43  |
| Age            | 0.01                            | 0.59   | -0.01 to 0.02  |
| Marital status | 0.47                            | 0.001  | 0.20 to 0.73   |
| SCL-10         | 0.40                            | 0.05   | 0.002 to 0.81  |
| MMSE           | -0.06                           | <0.001 | -0.09 to -0.03 |
| LSC-b          | -0.19                           | 0.003  | -0.33 to -0.07 |

95% CI: 95% confidence interval; SCL-10: Symptom Checklist-10; MMSE: Mini-Mental State Examination; LSC-b: Umea Life Satisfaction Checklist, satisfaction with ability to self-care.

through this model we could show the independency between improvement in ADL-function and life satisfaction in general and the "soft" predictors of level of home care services.

A limitation of this study was the design, as it was not possible to randomize the patients and there was no control group. A possible bias is that the first author worked at the rehabilitation centre during the study period.

We have not been able to identify other studies of the rehabilitation of elderly people that have been carried out in a primary healthcare setting like ours. The study rehabilitation centre, however, has similarities to intermediate care community hospitals in the UK, Finland, Norway, and the Netherlands (14–17). These are small hospitals (20–30 beds), anchored to primary healthcare, with few on-site diagnostic services, multi-disciplinary staffed and focusing on pre- and post-acute needs and on rehabilitation of older people. An important difference from our model is that community hospitals usually have geriatric consultants instead of, or in addition to, GPs. Loss of independence at 6 months after discharge was significantly less likely after rehabilitation of older people in community hospitals in the UK and Norway compared with prolonged general hospital care (18, 15). In our opinion the functional gain in these studies is consistent with the clinically significant and persistent improvement in SI in our study.

The costs of GP hospitals and intermediate care hospitals are lower than costs in general hospitals (19, 20), and may thus represent a cost-effective model for rehabilitation of older people. Defining the optimal setting and content of rehabilitation in primary healthcare is becoming increasingly important. The present study will therefore be followed up by a study comparing the outcome of rehabilitation of older people in primary healthcare with, vs without, a district rehabilitation centre. In conclusion, the present study demonstrates that older people with disabilities can be rehabilitated successfully by a multi-disciplinary primary healthcare team working in a structured manner in a district rehabilitation centre.

#### ACKNOWLEDGEMENT

We thank statistician Ingvild Dalen for providing advice on statistical analyses.

#### REFERENCES

- Jagger C, Matthews R, Spiers N, Brayne C, Comas-Herrera A, Robinson T, et al. Compression Or expansion of disability? Forecasting future disability levels under changing patterns of diseases. Final report. KF 117 02/06. Leicester: University of Leicester; 2006.
- Report to the Norwegian Parliament No. 21 (1998–1999). [To manage and be responsible. Towards a complete rehabilitation policy] (in Norwegian).
- Stewart DG, Phillips EM, Bodenheimer CF, Cifu DX. Geriatric rehabilitation. 2. Physiatric approach to the older adult. *Arch Phys Med Rehabil* 2004; 85: 7–13.
- Fjærtøft H, Indredevik B, Lydersen S. Stroke unit care combined with early supported discharge. Long term follow-up of a randomized controlled trial. *Stroke* 2003; 34: 2687–2692.
- Halbert J, Crotty M, Whitehead C, Cameron I, Kurrle S, Graham S, et al. Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome: a systematic review. *J Rehabil Med* 2007; 39: 507–512.
- Ward D, Drahota A, Gal D, Severs M, Dean TP. Care home versus hospital and own home environments for rehabilitation of older people. *Cochrane Database of Systematic Reviews* 2008; 4. CD003164. DOI: 10.1002/14651858.CD003164.pub.2.
- World Health Organization. International classification of functioning, disability and health. Final draft. Geneva: WHO; 2001.
- Bathen T, Vardeberg K. Test-retest Reliability of the Sunnaas ADL Index. *Scand J Occup Ther* 2001; 8: 140–147.
- Claesson L, Svensson E. Measures of order consistency between paired ordinal data: Application to the Functional Independence Measure and Sunnaas Index of ADL. *J Rehabil Med* 2001; 33: 137–144.
- Fugl-Meyer AR, Melin R, Fugl-Meyer KS. Life satisfaction in 18- to 64-year-old Swedes: in relation to gender, age, partner and immigrant status. *J Rehabil Med* 2002; 34: 239–246.
- Engedal K, Haugen PK, Gilje K, Laake P. Efficacy of short mental tests in the detection of mental impairment in old age. *Compr Gerontol A* 1988; 2: 87–93.
- Bour A, Rasquin S, Boreas A, Limburg M, Verhey F. How predictive is the MMSE for cognitive performance after stroke? *J Neurol* 2010; 257: 630–637.
- Strand BH, Dalgard OS, Tambs K, Rognerud M. Measuring the mental health status of the Norwegian population: a comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). *Nord J Psychiatry* 2003; 57: 113–118.
- Green J, Young J, Forster A, Mallinder K, Bogle S, Lowson K, et al. Effects of locality based community hospital care on independence in older people needing rehabilitation: randomised controlled trial. *BMJ* 2005; 331: 317–322.
- Garåsen H, Windspoll R, Johnsen R. Intermediate care at a community hospital as an alternative to prolonged general hospital care for elderly patients: a randomised controlled trial. *BMC Public Health* 2007; 7: 68.
- Aaraas I, Forde OH, Kristiansen IS, Melbu H. Do general practitioners hospitals reduce the utilisation of general hospital beds? Evidence from Finnmark County in North Norway. *J Epidemiol Community Health* 1998; 52: 243–246.
- Van Charante EM, Moll E, Hartman E, Yzermans J, Voogt E, Klazinga N, et al. The first general practitioner hospital in The Netherlands: towards a new form of integrated care? *Scand J Prim Health Care* 2004; 22: 38–43.
- Young J, Green J, Forster A, Small N, Lowson K, Bogle S, et al. Postacute care for older people in community hospitals: a multicenter randomized, controlled trial. *J Am Geriatr Soc* 2007; 55: 1995–2002.
- Hakaart-van Roijen L, Moll van Charante EP, Bindels PJE, Yzermans CJ, Rutten FFF. A cost study of a general practitioner hospital in the Netherlands. *Eur J Gen Pract* 2004; 10: 45–49.
- Garåsen H, Magnussen J, Windspoll R, Johnsen R. [Older patients in hospitals or in intermediate care wards – a cost analysis]. *Tidsskr Nor Lægeforen* 2008; 128: 283–285 (in Norwegian).









RESEARCH ARTICLE

Open Access

# Independence, institutionalization, death and treatment costs 18 months after rehabilitation of older people in two different primary health care settings

Inger Johansen<sup>1\*</sup>, Morten Lindbak<sup>1</sup>, Johan K Stanghelle<sup>2</sup> and Mette Brekke<sup>1</sup>

## Abstract

**Background:** The optimal setting and content of primary health care rehabilitation of older people is not known. Our aim was to study independence, institutionalization, death and treatment costs 18 months after primary care rehabilitation of older people in two different settings.

**Methods:** Eighteen months follow-up of an open, prospective study comparing the outcome of multi-disciplinary rehabilitation of older people, in a structured and intensive Primary care dedicated inpatient rehabilitation (PCDIR, n=202) versus a less structured and less intensive Primary care nursing home rehabilitation (PCNHR, n=100). Participants: 302 patients, disabled from stroke, hip-fracture, osteoarthritis and other chronic diseases, aged ≥65years, assessed to have a rehabilitation potential and being referred from general hospital or own residence. Outcome measures: Primary: Independence, assessed by Sunnaas ADL Index(SI). Secondary: Hospital and short-term nursing home length of stay (LOS); institutionalization, measured by institutional residence rate; death; and costs of rehabilitation and care. Statistical tests: T-tests, Correlation tests, Pearson's  $\chi^2$ , ANCOVA, Regression and Kaplan-Meier analyses.

**Results:** Overall SI scores were 26.1 (SD 7.2) compared to 27.0 (SD 5.7) at the end of rehabilitation, a statistically, but not clinically significant reduction ( $p=0.003$  95%CI(0.3-1.5)). The PCDIR patients scored 2.2points higher in SI than the PCNHR patients, adjusted for age, gender, baseline MMSE and SI scores ( $p=0.003$ , 95%CI(0.8-3.7)). Out of 49 patients staying >28 days in short-term nursing homes, PCNHR-patients stayed significantly longer than PCDIR-patients (mean difference 104.9 days, 95%CI(0.28-209.6),  $p=0.05$ ). The institutionalization increased in PCNHR (from 12%-28%,  $p=0.001$ ), but not in PCDIR (from 16.9%-19.3%,  $p=0.45$ ). The overall one year mortality rate was 9.6%. Average costs were substantially higher for PCNHR versus PCDIR. The difference per patient was 3528€ for rehabilitation ( $p<0.001$ , 95%CI(2455-4756)), and 10134€ for the at-home care ( $p=0.002$ , 95%CI(4066-16202)). The total costs of rehabilitation and care were 18702€ (=1.6 times) higher for PCNHR than for PCDIR.

**Conclusions:** At 18 months follow-up the PCDIR-patients maintained higher levels of independence, spent fewer days in short-term nursing homes, and did not increase the institutionalization compared to PCNHR. The costs of rehabilitation and care were substantially lower for PCDIR. More communities should consider adopting the PCDIR model.

**Trial registration:** Clinicaltrials.gov ID NCT01457300

**Keywords:** Aged and >80, Community rehabilitation, Activities of daily living, Costs

\* Correspondence: inger.johansen@medisin.uio.no

<sup>1</sup>Department of General Practice/General Practice Research Unit, Institute of Health and Society, University of Oslo, PO Box 1130, Oslo, Blindern N-0318, Norway

Full list of author information is available at the end of the article

## Background

The main goal of rehabilitation is to achieve optimal functioning in interaction with the environment [1]. Older people express that their primary aim of rehabilitation after a disabling event is to return to their own residences and to live there as long as they wish with an optimal independence and quality of life [2,3]. To develop cost-effective rehabilitation systems is a growing challenge as the proportion of disabled older people is expected to increase substantially in developed countries in the coming decades [4,5]. The most common disabling conditions of older age are stroke and hip fracture, and more than half of the total health care costs of these conditions are related to long-term care [6,7].

Rehabilitation of older people is provided at the specialized-, intermediate- and primary health care level. At each level there are different rehabilitation programmes. Specialized- and intermediate rehabilitation can be inpatient, outpatient or home based and adapted for older patients with specific or different diagnoses. However, it is not clear if any of these programmes are cost-effective.

At the specialized level it has been shown that rehabilitation of older patients with different diagnoses in geriatric hospital departments improves function and reduces institutionalization and mortality, to a higher degree than in usual care [8]. Geriatric day hospital rehabilitation has also proven successful in terms of independence [9]. No difference in cost-effectiveness was found in a multi-centre RCT comparing rehabilitation of patients with different conditions in a geriatric hospital department with standard care [10]. Others have shown that the one year costs of medical care after intensive rehabilitation of patients with hip-fractures did not differ significantly from medical care after standard hospital rehabilitation [11]. An acute stroke-unit care combined with an Early Supported Discharge programme may reduce the length of hospital stay and improve independence without increasing the costs of outpatient rehabilitation compared with traditional stroke care [12]. Intermediate level services like community hospitals, Early Supported Discharge services and home based rehabilitation also report on gain in the level of independence of older patients with different conditions [9,13,14]. Post-acute treatment and rehabilitation of older patients in a community hospital were cheaper than rehabilitation in a general hospital, probably due to fewer readmissions [15]. A recent review paper concluded that programmes focusing on multi-disciplinary approach, accelerated rehabilitation and continuity of care, can reduce the care costs after hip-fractures [7].

However, there is little information about short- and long-term outcomes and costs of comprehensive primary health care rehabilitation of older people.

Due to the increased proportion of older people in the society, the shortage of hospital beds and a limited number of specialists in geriatric and rehabilitation medicine, it is important to study if a proportion of rehabilitation of older people can be managed successfully at the primary health care level. In a previous study we demonstrated that older patients disabled due to different conditions who received multi-disciplinary, structured and intensive rehabilitation in a primary health care inpatient dedicated rehabilitation centre (PCDIR) resulted in a higher level of independence within a shorter rehabilitation period as compared to standard primary health care rehabilitation in short-term beds in nursing homes (PCNHR). This difference sustained at three months follow-up [16,17]. In the present study we wanted to explore outcomes of the two rehabilitation models at 18 months follow-up.

## Aims

The primary aim of the study was to compare the level of independence of older patients 18 months after PCDIR and PCNHR and to study how this was influenced by patient characteristics, baseline diagnosis, cognitive and emotional status, and the duration and method of rehabilitation.

A secondary aim was to analyse hospital and short-term nursing home LOS, institutional residence rate and mortality during 18 months after the rehabilitation, and to examine how these variables were influenced by patient characteristics, baseline diagnosis, cognitive and emotional status, and the rehabilitation method.

A tertiary aim was to study the costs of rehabilitation and care in the two rehabilitation models.

## Methods

### Rehabilitation services for older people in Norway

In Norway the health care is mainly public and is divided into the specialized and the primary levels. Specialized rehabilitation services are provided both by the public and private health care, mainly in inpatient settings. From 2006 the private rehabilitation institutions have been partly funded through the public specialized health care system by a national agreement. The primary level rehabilitation services for older people are mainly provided in short-term beds in nursing homes, beds which are also intended to serve the relief-, palliative- and sub-acute care needs. Some municipalities have Home based rehabilitation served by multi-disciplinary ambulatory teams and some have dedicated inpatient facilities, as in the present study, but these services are in a minority. Like in other countries Norway has also through the last two decades developed some intermediate care rehabilitation services based on a shared care between the specialized and primary health care.



## Study design

This was an 18 months follow-up of an open, prospective comparative observational study.

## Setting

The study was carried out in two districts in the county of Vestfold, Norway. The number of inhabitants and the demographic, rural and urban distribution of people in the two districts were similar. In one district the multi-disciplinary primary care based rehabilitation of older patients was provided in a dedicated inpatient centre (PCDIR), and in the other district in short-term beds in nursing homes (PCNHR). The key features of the setting and content of the two rehabilitation models are shown in Table 1, which is a modification of a more extensive table published elsewhere[17]. The PCDIR study centre has 16 beds and covers a population of 40,000 inhabitants. It is a completely free-standing facility. The patients pay out of pocket 130NOK (=16€) per day for this care, which is based on a national agreement for services in all Norwegian primary care short-term institutions. The centre has a 50% part-time general practitioner involvement, full-time four physio- and three occupational therapists, in addition to the nursing care personnel. The assessment, rehabilitation process and focus in the PCDIR centre is very similar to the essential elements of successful rehabilitation described in the WHO rehabilitation cycle [1]. The recruitment period was from June 2006 until April 2009. The exposure time was the rehabilitation period. In our previous studies we looked at data collected at the beginning, two weeks into, at completion of and three months after the rehabilitation. In the present study we collected data at 18 months after the rehabilitation. Data were collected by the first author,

by qualified personnel in the rehabilitation centre and by two project assistants. The first author coordinated the data collection.

## Participants

The study population was disabled older people living in the two districts described above. They were admitted to rehabilitation either post-acute from the district general hospital or from their own residences. Inclusion criteria were both genders and age  $\geq 65$  years. The referral diagnoses were disability due to stroke, osteoarthritis, hip fracture and "others" (ageing disability, loss of function due to long periods of hospitalization and chronic, slowly progressing diseases). Only patients considered to have a rehabilitation potential were included. Rehabilitation potential was defined as the physiological and psychological possibilities of a disabled patient to restore, improve or maintain an optimal level of function and quality of life [6]. Assessment of the rehabilitation potential was based on a total evaluation of the level of ADL, cognitive, emotional and physical function, as well as the patient's motivation to an active rehabilitation process. The assessment was made by a multi-disciplinary team and in the same way for all patients. Details as to the minimum required ADL and cognitive levels are described in the section "Variables and outcome measurements". Patients with active psychoses or severe depressions with a lack of initiative were not included. Other exclusion criteria were patients with rapidly progressive diseases, severe chronic obstructive pulmonary disease, unstable angina pectoris and not clarified cardiac arrhythmias. Patients were included consecutively upon admission to rehabilitation. Approximately half of the patients in both models were admitted from the district general hospital and the other

**Table 1 Main characteristics of Primary Care Dedicated Inpatient Rehabilitation and Primary Care Nursing Home Rehabilitation**

| Rehabilitation feature  | PCDIR <sup>1</sup>  | PCNHR <sup>2</sup>  |
|---|---|---|
| Multi-dimensional assessment  | Standardized  | Not standardized  |
| Professionals of the rehabilitation team                                | GP, nurse, physio- and occupational therapist.<br>Other professionals at need | GP, nurse, physio- and occupational therapist.<br>Other professionals at need |
| Rehabilitation arena  | Short term beds in primary care dedicated inpatient rehabilitation centre     | Short-term beds in primary care nursing homes                                 |
| Focus of the setting  | Continuous rehabilitation focus in an optimistic and realistic setting        | Frequent shift of focus between rehabilitation and care                       |
| Rehabilitation process  |   |   |
| Goals, plan, intervention tailored to the patient                       | Always  | Occasional  |
| Measurement instruments   | Always, 3-4 regular   | Occasional  |
| Collaboration between patient, staff, relatives and primary health care | Close, in at least weekly meetings  | Occasional  |
| Training: Physical-, functional-, ADL-                                  | In groups, one-by-one and self-training                                       | In groups, one-by-one and self-training                                       |
| Training intensity/frequency  | Three hours/day   | Two hours/day   |

PCDIR= Primary Care Dedicated Inpatient Rehabilitation 2. PCNHR= Primary Care Nursing Home Rehabilitation.

half directly from their own residences. The recruitment process is fully described in a previous paper [17].

#### Variables and outcome measurements

The validated scale Sunnaas ADL Index, SI [18] was the main outcome measure and indicator of independence. SI measures 12 activities of daily life. Each activity has a score from 0–3, where 0=totally dependent and 3=independent. The total maximum score of 36 means totally independent. Scores <12 means that the patient needs help from one or more persons in nearly all ADL situations, which in most cases indicate a marginal rehabilitation potential. The majority of the study patients had baseline SI scores from 20–25.

**MMSE**, Mini Mental Status Evaluation [19], measures cognitive function, which was considered a possible predictor of outcome. Scores are from 0–30. Patients with hip-fracture and mild (MMSE score 18–23) or moderate (MMSE score 12–17) dementia can often return to the community if they are provided with active geriatric rehabilitation [20,21]. In our study we did not consider patients to have a rehabilitation potential if the MMSE scores were <18-20, but if the pre-rehabilitation motor ability was good, they were included. MMSE was recorded two weeks into the rehabilitation to avoid recording incidental confusion at baseline.

**SCL-10**, Symptom Check List-10 [22] is a validated questionnaire mapping emotional health during the previous week, particularly anxiety and depression, and was included as a possible predictor of outcome. SCL-10 comprises ten questions with scores from 1–4. The final score is the total score sum divided by ten. Scores >1.85 indicate severe emotional problems. SCL-10 was recorded two weeks into rehabilitation to avoid recording possible emotional instability at baseline.

Other secondary outcome variables were hospital and short-term nursing home LOS, institutionalization as measured by institutional residence rate, and mortality during 18 months after the rehabilitation. The source of this information was the GP- and nursing care files of the patients and the official Norwegian Death Registry.

Age, gender, marital status and diagnostic group were recorded at baseline. Type of residence was recorded at baseline and at 18 months follow-up.

#### Cost calculations

Cost calculations were based on average costs per patient according to the 2009 price level. (8 Norwegian kroner (NOK)=1 Euro(€)). The per patient PCDIR costs (2750NOK=343€/day) and the hospital costs (4000NOK=500€/day) were given from the official accounts of the specific institutions. The per patient nursing home costs (2280NOK=285€/day) were given from Statistics Norway[23]. The per patient costs/hour

of at-home care (624NOK=78€/hour) were calculated from data provided by the community administrations of the study districts and were based on the average costs of nursing, care, utensils, transportation and administration. The level of at-home care (hours/day) was recorded in the previous studies at end of and three months after the rehabilitation [17]. These levels correlated very strongly to the corresponding SI scores (PCDIR:-0.7 and PCNHR:-0.9 ( $p < 0.001$ ), Pearson's correlation coefficient). Based on this very strong correlation, the fact that there was no clinically significant change in SI scores during the 18months follow-up, and that the difference in SI scores between the two models sustained (Result section, present paper), we calculated that the level of at-home care services followed the same pattern as the SI scores during the 18 months follow-up.

#### Sample size

A two points difference in SI between the two models was judged to be clinically significant. Power calculation estimated a need for including 100 patients in each model, based on a beta of 0.90, an alpha of < 0.05 and SD=4.3 in SI. We decided to include 200 patients in PCDIR to ensure enough patients for subgroup analyses [16].

#### Statistics

Data were analyzed in SPSS version 19.0 for Windows. Two groups of continuous, symmetrically distributed variables were compared by T-tests, and several groups by one way ANOVA (posthoc test if  $p < 0.05$ ). Asymmetrically continuous variables were compared by Mann–Whitney Wilcoxon-test. Correlations between continuous variables were analysed by Pearson's (symmetrical distribution) or Spearman's (asymmetrical distribution) correlation coefficient. Categorical variables were compared by Pearson's  $\chi^2$  test. Differences in SI gain between the groups were analysed by ANCOVA (Analysis of covariance) to correct for SI imbalance at baseline [24]. Possible predictors of outcome were identified by univariate regression analysis, and statistically significant variables were analysed in multiple linear regression analysis to identify confounders and true predictors. Survival was analysed by Kaplan-Meier analysis.

#### Ethics

The study was approved by the Regional Ethics Committee for Medical Research and by the Norwegian Social Science Data Services.

The study clinicaltrials.gov ID is NCT01457300.

#### Results

##### Participants

In total 302 patients were recruited into the study at baseline, 202 into PCDIR and 100 into PCNHR. Eligible

patients were recruited consecutively throughout the recruitment period. All eligible patients were asked and all but one accepted and gave informed consent to participate in the study. Consent was given on admission to the rehabilitation. Two of the patients in PCDIR were excluded shortly after inclusion due to a serious stroke and a leg amputation, respectively. Totally 43 patients died during the 18 months follow-up period, and two patients were lost to follow-up, which left 255 patients for follow-up assessment at 18 months.

### Descriptive data

Table 2 shows patient characteristics, diagnoses and baseline cognitive and emotional status of the total study population and the PCDIR and PCNHR populations surviving at 18 months follow-up. The women in both models were older than the men and more frequently

lived alone and suffered from hip fracture. The men more often suffered from stroke.

### Level of and predictors for ADL-function at 18 months follow-up

The patients scored 26.1 (SD 7.2) points in SI at 18 months compared to 27.0 (SD 5.7) points at end of the rehabilitation period, a statistically, but not clinically significant reduction of 0.9 point ( $p=0.003$  95%CI(0.3-1.5), Paired Samples T-T).

The predictor analyses showed that SI at 18 months follow-up was independent of gender, marital status, diagnoses, emotional status and the duration of the rehabilitation and was predicted by age, cognitive status and the rehabilitation method. The exact results were that if other variables were kept constant, a one year higher age meant a 0.1 point lower level of SI, a one

**Table 2 Characteristics of older patients surviving at 18 months after primary care inpatient rehabilitation**

|                                     | Total population       | PCDIR <sup>1</sup> | PCNHR <sup>2</sup> |
|-------------------------------------|------------------------|--------------------|--------------------|
| Number of patients (n)              | 255                    | 166                | 89                 |
| Age y mean (SD, min-max)            | 81.7 (6.8, 65-96)      | 81.8 (5.9, 66-95)  | 81.5 (6.6, 66-96)  |
| Gender men/women (n)                | 74/181                 | 45/121             | 29/60              |
| Residence (N=254)                   |                        |                    |                    |
| Own (n)                             | 198 (78%)              | 134 (81%)          | 64 (72%)           |
| Care-flat/long term nursing home(n) | 56 (22%)               | 32 (19%)           | 25 (28%)           |
| Marital status: Married (n)         | 98 (38%)               | 60 (36%)           | 38 (43%)           |
| Alone (n)                           | 157 (62%)              | 106 (64%)          | 51 (57%)           |
| Diagnoses (N=254)                   |                        |                    |                    |
| Stroke (n)                          | 43 (17%)               | 30 (18%)           | 13 (15%)           |
| Osteoarthritis (n)                  | 34 (13%)               | 20 (12%)           | 14 (16%)           |
| Fracture (n)                        | 92 (36%)               | 66 (40%)           | 26 (29%)           |
| Other (n)                           | 85 (34%)               | 49 (30%)           | 36 (40%)           |
| MMSE <sup>3</sup> , mean (SD)       | 25.3 (3.9)             | 25.2               | 25.3               |
| (CI) (N=255)                        | (24.8-25.8)            |                    |                    |
| SCL10 <sup>4</sup> , mean (SD)      | 1.4 (0.3)              | 1.4                | 1.4                |
| (CI) (N=255)                        | (1.3-1.4)              |                    |                    |
| Men/women                           |                        |                    |                    |
| Age, years                          | 79.7/82.5 <sup>5</sup> |                    |                    |
| Living alone, %                     | 36/72 <sup>6</sup>     |                    |                    |
| Fracture, %                         | 27/40 <sup>6</sup>     |                    |                    |
| Stroke, %                           | 30/12 <sup>6</sup>     |                    |                    |

1. PCDIR=Primary Care Dedicated Inpatient Rehabilitation

2. PCNHR=Primary Care Nursing Home Rehabilitation

3. MMSE=Mini Mental Status Evaluation

4. SCL10=Symptom Checklist 10

5. Independent Samples T-test,  $p<0.001$  95% CI(1.0-4.7)

6. Pearson  $\chi^2$   $p=0.002$

**Table 3 Predictors of independence<sup>1</sup> at 18 months after primary care inpatient rehabilitation of older people**

|                       | USB <sup>2</sup> | p     | 95% CI of B |
|-----------------------|------------------|-------|-------------|
| Constant              | 13.5             | .013  |             |
| Gender                | -.7              | .376  | -2.2-.8     |
| Age                   | -.1              | .040  | -.2-.005    |
| SI baseline           | .5               | <.001 | .4-.6       |
| MMSE                  | .5               | <.001 | .3-.7       |
| Rehabilitation Method | 2.2              | .003  | .8-3.7      |

Dependent variable SI 18 months after the rehabilitation.

<sup>1</sup> Independence=Ability to perform activities of daily living=Sunnaas ADL Index=SI.

<sup>2</sup> USB=Ustandardized Coefficient B in a Multiple linear regression analysis, corrected for gender, age and SI at baseline, shows the change in SI at 18 months after rehabilitation (USB) when the variable changes one point.

point higher MMSE score meant a 0.5 point higher level of SI and a change in rehabilitation method from PCNHR to PCDIR meant a 2.2 points higher level of SI [Table 3].

#### Short-term nursing home and hospital LOS, institutionalization and death until 18 months follow-up

Ninety-four (37%) of the patients had short-term nursing home stays, and the patients in PCNHR had longer LOS compared to PCDIR (Table 4). Sixty six (26%) of the patients had hospital stays, mean 16.1 days in PCDIR (n=41), and 9.6days in PCNHR (n=25). The difference was not statistically significant (p=0.1 Independent Samples T-test).

Sixteen (11.8%) of the patients aged ≥80years resided in a nursing home at 18 months follow-up (9 (9.8%) in PCDIR and 7(15.6%) in PCNHR), compared to no patients at baseline. The proportion of patients residing in a care-flat or nursing home increased significantly in PCNHR, (from 12(12.0%) to 25(28.1%) (McNemar, p=0.001)), but not in PCDIR (from 28(16.9%) to 32(19.3%) (McNemar p=0.45)).

Forty-three of the 298 patients (Excluded=2, Lost to follow-up=2) died during the study period, giving a one year mortality of 9.6%. The patients who died were older than the surviving patients and had lower SI at the beginning and end of the rehabilitation period, (age at baseline 82.9 versus 80.2 years, p=0.01, 95%CI(0.5-4.9), SI at beginning: 20.9 versus 23.3, p=0.04 95%CI(0.1-4.7), SI at end: 24.4 versus 27.0, p=0.03 95%CI(0.2-5.0) - Independent Samples T-test). The difference in survival curves for the patients in the two rehabilitation models was not statistically significant (Figure 1).

#### Predictors of number of days in nursing homes

The predictor analyses showed that the number of short-term days in nursing homes were independent of gender, age, marital status, emotional status, diagnoses and the rehabilitation method and predicted negatively by cognitive status and SI at end of rehabilitation. The exact results were that if other variables were kept constant, a one point higher MMSE score meant 6.4 fewer days in nursing homes (p<0.001 95%CI(-3.1—9.7)) and a one point higher SI at end of rehabilitation meant 5.4 fewer days in nursing homes (p<0.001 95%CI (-3.1—7.7)).

#### Rehabilitation and care costs

The average rehabilitation costs were 3 528€ higher per patient in PCNHR compared to PCDIR and the at-home care costs were 10 134€ higher. Both differences were statistically significant (Table 5). The mean costs of nursing home care per patient staying >28 days, which included 19% of the patients in both models, were 29 897€ higher in PCNHR compared to PCDIR, a statistically significant difference (Table 5). The average total costs per patient for rehabilitation, at-home, hospital and short-term nursing home care were 48 147€ in PCNHR (Table 5), which was 1.6 times higher compared to in PCDIR.

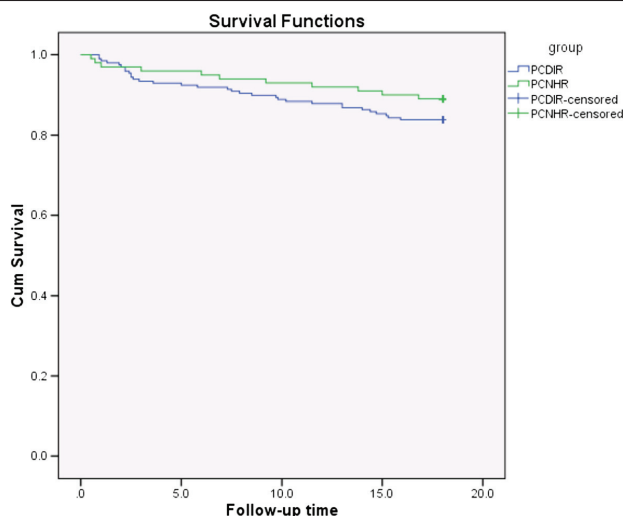
**Table 4 Mean days in short-term nursing homes from 0–18 months after primary care inpatient rehabilitation of older people in two different settings**

|                                  | PCDIR <sup>1</sup> | PCNHR <sup>2</sup> | Difference mean (95%CI) <sup>3</sup> | P of the difference <sup>3</sup> |
|----------------------------------|--------------------|--------------------|--------------------------------------|----------------------------------|
| Days in short-term nursing homes |                    |                    |                                      |                                  |
| 0 days                           | n=102(62%)         | n=58(66%)          |                                      |                                  |
| 1-28 days, Mean                  |                    |                    |                                      |                                  |
| (95%CI)                          | 16.9(15.1-18.8)    | 20.5(16.8-24.1)    | 3.6(-7.1-0.1)                        | 0.06                             |
|                                  | (n=32, 19%)        | (n=13, 15%)        |                                      |                                  |
| >28 days,                        |                    |                    |                                      |                                  |
| Mean(95%CI)                      | 148.5(91.7-205.6)  | 253.6(150.8-356.4) | 104.9(0.28-209.6)                    | 0.05                             |
|                                  | (n=32, 19%)        | (n=17, 19%)        |                                      |                                  |

<sup>1</sup> Primary Care Dedicated Inpatient Rehabilitation.

<sup>2</sup> Primary Care Nursing Home Rehabilitation.

<sup>3</sup> Independent Samples T-test.



**Figure 1 Survival curves(Kaplan-Meier) for older patients 0–18 months after primary care rehabilitation in two different settings.** Log Rank (Mantel-Cox)  $\chi^2$  Test  $P=0.23$ . PCDIR: Primary Care Dedicated Inpatient Rehabilitation PCNHR: Primary Care Nursing Home Rehabilitation Follow-up time in months.

## Discussion

This study showed that disabled older patients who received multi-disciplinary PCDIR maintained a statistically and clinically significant higher level of independence from end of rehabilitation until 18 months afterwards, spent fewer days in short-term nursing homes and did not increase the institutional residence rate, compared to patients who received PCNHR. The rehabilitation and care costs of PCDIR were substantially lower.

Irrespective of the type of rehabilitation, cognitive status was a predictor of both the level of independence and the number of short-term days in nursing homes. This is consistent with our previous findings at end of and three months after the rehabilitation [17]. According to our experience the ability of initiative and to take instructions were the cognitive features of greatest importance for successful rehabilitation. Several studies identify cognitive status as a predictor of rehabilitation outcomes [25,26].

Due to the disability of the study population, we expected that the institutional residence rate at 18 months follow-up would be higher than in the general Norwegian population at the same age. However, while 9.8% of the PCDIR and 15.6% of the PCNHR patients  $\geq 80$  years lived in nursing homes, 14.3% of the general Norwegian population of the same age group resided in nursing homes in 2007[27]. Our data indicate that PCDIR, if adopted on a broader scale, may reduce the number of Norwegians  $\geq 80$  years living in nursing homes (in 2007  $n=31,000$ ) by several thousands.

The one year mortality of the total study population was higher than in the general Norwegian population at the same age, 9.6% versus 6%, respectively [28]. Mortality rates reported after post-acute rehabilitation of older people are about 20% [29,30]. Only half of the patients in our study were in post-acute rehabilitation, which may explain some of the difference. Furthermore, the major causes of death in post-acute rehabilitation and care studies are cardiovascular, infectious and malignant diseases. Only a few patients with these diagnoses were included in our study [17]. Due to their higher ADL levels, we expected the PCDIR patients to have a better survival than the PCNHR patients. Surprisingly, there was a not statistically significant tendency towards the opposite. This may be explained by the higher morbidity as shown by more days in hospital.

The PCDIR intervention in this study was both more effective and less expensive compared to the PCNHR, thus meeting the criteria for a preferred strategy [7]. In such cases the health-care decisions are obvious and calculation of a cost-effective ratio is not necessary. The main reasons for the lower costs of the PCDIR were the shorter rehabilitation stay and the lower at-home care needs compared to the PCNHR. The costs of medication, transportation and outpatient physician and physiotherapy visits were not recorded, but we could not give any reasons that these costs would influence the cost differences in our study. The average total costs per patient were 1.6 times higher in PCNHR during 18 months

**Table 5 Rehabilitation and care costs<sup>1</sup> per patient during 18 months after primary care inpatient rehabilitation of older people**

| Setting                         | PCDIR <sup>2</sup> mean(CI)              | PCNHR <sup>3</sup> mean(CI)              | Cost difference (PCNHR-PCDIR) mean (CI) <sup>4</sup> | p <sup>4</sup> of the cost difference |
|---------------------------------|--|--|--|---------------------------------------|
| Rehabilitation <sup>5</sup>     | 7 443<br>(6 963–7 923)                   | 10 972<br>(9 376–12 369)                 | 3 528<br>(2 455–4 756)                               | <0.001                                |
| At-home Care <sup>6</sup>       | 10 890<br>(10 221–11 772)                | 20 995<br>(18 689–23 301)                | 10 134<br>(4 066–16 202)                             | 0.002                                 |
| Hospital <sup>6</sup>           | 2 020<br>(1 180–2 865)                   | 1 360<br>(550–2 165)                     | –660<br>(–600–1 950)                                 | 0.3                                   |
| Nursing home total <sup>6</sup> | 9 092<br>(5 301–13 253)                  | 14 820<br>(6 897–22 743)                 | 5 728<br>(–3 078–14 505)                             | 0.2                                   |
| Sum rehabilitation and care     | 29 445                                   | 48 147                                   | 18 702   |                                       |
| Nursing home 0 days             | 0 (n=102, 62%)                           | 0 (n=58, 66%)                            | 0  |                                       |
| Nursing home 1–28 days          | 4 817<br>(4 304–5 358)<br>(n=32, 19%)    | 5 843<br>(4 788–6 869)<br>(n=13, 15%)    | 1 026<br>(–29–2 021)                                 | 0.06                                  |
| Nursing home >28 days           | 42 380<br>(26 135–58 596)<br>(n=32, 19%) | 72 276<br>(42 978–101574)<br>(n=17, 19%) | 29 897<br>(80–59 736)                                | 0.05                                  |

<sup>1</sup> Costs in €(2009 price level, 1€=8NOK).

<sup>2</sup> Primary Care Dedicated Inpatient Rehabilitation.

<sup>3</sup> Primary Care Nursing Home Rehabilitation.

<sup>4</sup> Independent Samples T-test.

<sup>5</sup> PCDIR: n=200, PCNHR: n=100.

<sup>6</sup> PCDIR: n=166, PCNHR: n=89.

follow-up. However, if further survival time is taken into account, the cost differences might be even higher. The remaining life time of 82 years old Norwegians is about seven years (men: six years, women: eight years) [31].

A limitation to the study was the non-randomized design. We wanted to perform a study of the “real-life health care”, and a study of level 2 design was our nearest option to achieve more knowledge about this important and poorly investigated field. The first author worked as a GP in the rehabilitation centre when the PCDIR patients were recruited, which could have introduced a bias. She did the general clinical evaluation of the patients, but was not involved in the training of the patients and did none of the SI scores. Methodical weaknesses have been thoroughly discussed in a previous paper [17]. On the other hand, patient features likely to influence the outcomes were not different in the two rehabilitation models [Table 2], and all participants were considered to have a rehabilitation potential, which was assessed in the same way in the two models. Most of the procedures and decisions were standardized.

The measurement scales used in this study are proven to be valid, reliable and sensitive to change over time. SI is not widely used internationally, but it is the commonly used ADL-scale in primary care in the study county. The

inter-item consistency between the internationally commonly used FIM and SI is high for many items, even if differences also exist [32]. We believe that when clinically significant improvements in different ADL-scales are defined, it is possible to compare different ADL-scales in terms of level of independence.

We have not found other studies evaluating the long-term outcomes of a dedicated primary health care based rehabilitation similar to the present model. However, both intermediate and specialized multi-disciplinary, inpatient rehabilitation of older people have shown a benefit in long-term (3-12months) outcomes compared to standard community or general hospital care [8,29,33,34]. Studies of these rehabilitation programmes for older people in general-, orthopedic- and stroke rehabilitation report higher long-term levels of independence [8,29,33-35] and lower long-term levels of institutionalization [8,33,35] and mortality [8,29,35,36]. More intensive exercise increases the success of hip-fracture programmes [37,38].

Cost-saving effects of different rehabilitation strategies are unclear, and it is difficult to compare costs across countries since both the reimbursement systems, delivery agreements and the price levels differ. Norwegian community hospitals are likely to provide health care at lower costs than alternative models of care, like general

hospitals, nursing homes and at-home care [39]. A community hospital in the Netherlands was also shown to be a cost-saving alternative for older patients in need of intermediate medical and nursing home care between hospital and at-home care [40]. The lower one year costs of a Norwegian post-acute community hospital compared to a general hospital might be out-weighed by a higher proportion of the patients residing in a nursing home at follow-up [15]. Sub-acute nursing homes were more effective than traditional nursing homes in returning patients aged  $\geq 65$  years with stroke to the community, but the Medicare costs were greater [41].

The PCDIR model includes the main features of the WHO rehabilitation cycle [1]. We believe that rehabilitation programmes which adhere to this cycle are more likely to be beneficial [8].

## Conclusions

This study shows that disabled older people who receive multi-disciplinary PCDIR, maintain higher levels of independence, spend fewer days in short-term nursing homes and do not have increased institutionalization during 18 months follow-up, compared to disabled older people who receive multi-disciplinary PCNHR. The PCDIR model is shown to be both more effective and less expensive. To sustain independence and reduce institutionalization and treatment costs among older people, more communities should consider adopting the PCDIR model, which includes the main features of the WHO rehabilitation cycle, into the primary health care.

## Abbreviations

PCDIR: Primary Care Dedicated Inpatient Rehabilitation; PCNHR: Primary Care Nursing Home Rehabilitation; SI: Sunnaas ADL Index; MMSE: Mini Mental Status Evaluation; SCL10: Symptom Checklist 10; LOS: Length of stay.

## Competing interests

The authors declare that they have no competing interests.

## Authors' contributions

IJ conceived the study and contributed substantially to its design and the collection of data. She performed the statistical analyses, interpreted the data and drafted the manuscript in collaboration with MB, who was the main supervisor. IJ wrote the paper. MB, ML and JKS contributed substantially to the design of the study. ML and JKS participated in the interpretation of the data and revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

## Acknowledgements

We thank Truls E. Bjerklund Johansen who contributed substantially in revising the manuscript critically for important intellectual content. IJ received PhD scholarship from the Norwegian General Practice Research Foundation. MB and ML are professors at the Department of General Practice, University of Oslo, Norway and JKS at Sunnaas University Hospital and Medical Faculty, University of Oslo, Norway. The data collection was funded by The Norwegian Medical Association's Foundation for quality improvement and patient safety.

## Author details

<sup>1</sup>Department of General Practice/General Practice Research Unit, Institute of Health and Society, University of Oslo, PO Box 1130, Oslo, Blindern N-0318,

Norway. <sup>2</sup>Sunnaas Rehabilitation Hospital and Medical Faculty, University of Oslo, Oslo, Norway.

Received: 16 June 2012 Accepted: 12 November 2012

Published: 14 November 2012

## References

- Stucki G, Cieza A, Melvin J: **The international classification of functioning, disability and health (ICF): a unifying model for the conceptual description of the rehabilitation strategy.** *J Rehabil Med* 2007, **39**:279-285.
- Gillsjo C, Schwartz-Barcott D, von P: **I: Home: the place the older adult cannot imagine living without.** *BMC Geriatr* 2011, **11**:10.
- Fange A, Ivanoff SD: **The home is the hub of health in very old age: findings from the ENABLE-AGE project.** *Arch Gerontol Geriatr* 2009, **48**:340-345.
- WHO: **Active ageing: Towards age-friendly primary health care.** 2004. ISBN 92 4 159218 4.
- Jagger C, Matthews R, Spiers N, Brayne C, Comas-Herrera A, Robinson T, Lindesay J, Croft P: **Compression or Expansion of Disability? Forecasting Future Disability Levels Under Changing Patterns of Diseases. Final report.** University of Leicester; 2006. KF 117 02/06.
- Norwegian government's white paper: **'Responsibility and empowerment'.** 1998.
- Haentjens P, Lamraski G, Boonen S: **Costs and consequences of hip fracture occurrence in old age: an economic perspective.** *Disabil Rehabil* 2005, **27**(18-19):1129-1141.
- Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM: **Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomized controlled trials.** *BMJ* 2010, **340**:c1718. doi:10.1136/bmj.c1718.
- Forster A, Young J: **Community rehabilitation for older people: day hospital or home-based services?** *Age Ageing* 2010, **0**:1-3.
- Kehusmaa S, Autti-Ramo I, Valaste M, Hinkka K, Rissanen P: **Economic evaluation of a geriatric rehabilitation programme: a randomized controlled trial.** *J Rehabil Med* 2010, **42**(10):949-955.
- Huusko TM, Karppi P, Avikainen V, Kautiainen H, Sulkava R: **Intensive geriatric rehabilitation of hip fracture patients: a randomized, controlled trial.** *Acta Orthop Scand* 2002, **73**(4):425-431.
- Fjaertoft H, Indredavik B, Magnussen J, Johnsen R: **Early supported discharge for stroke patients improves clinical outcome. Does it also reduce use of health services and costs? One-year follow-up of a randomized controlled trial.** *Cerebrovasc Dis* 2005, **19**(6):376-383.
- Garasen H, Windspoll R, Johnsen R: **Intermediate care at a community hospital as an alternative to prolonged general hospital care for elderly patients: a randomised controlled trial.** *BMC Public Health* 2007, **7**:68.
- Fjaertoft H, Indredavik B, Lydersen S: **Stroke unit care combined with early supported discharge: long-term follow-up of a randomized controlled trial.** *Stroke* 2003, **34**(11):2687-2691.
- Garasen H, Magnussen J, Windspoll R, Johnsen R: **[Elderly patients in hospital or in an intermediate nursing home department—cost analysis].** *Tidsskr Nor Lægeforen* 2008, **128**(3):283-285.
- Johansen I, Lindbaek M, Stanghelle JK, Brekke M: **Effective rehabilitation of older people in a district rehabilitation center.** *J Rehabil Med* 2011, **43**(5):461-464.
- Johansen I, Lindbaek M, Stanghelle JK, Brekke M: **Structured community-based inpatient rehabilitation of older patients is better than standard primary health care rehabilitation – an open comparative study.** *Disabil Rehabil* 2012, **1**:1-8. doi:10.3109/09638288.2012.667193. Early online.
- Bathen T, Vardeberg K: **Test-retest Reliability of the Sunnaas ADL Index.** *Scand J Occup Ther* 2001, **8**:140-147.
- Engedal K, Haugen PK, Gilje K, Laake P: **Efficacy of short mental tests in the detection of mental impairment in old age.** *Compr Gerontol A* 1988, **2**:87-93.
- Beloosesky Y, Grinblat J, Epelboym B, Weiss A, Grosman B, Hendel D: **Functional gain of hip fracture patients in different cognitive and functional groups.** *Clin Rehabil* 2002, **16**:321-328.
- Huusko TM, Karppi P, Avikainen V, Kautiainen H, Sulkava R: **Randomised, clinically controlled trial of intensive geriatric rehabilitation in patients with hip fracture: subgroup analysis of patients with dementia.** *BMJ* 2000, **321**:1107-1111.



22. Strand BH, Dalgard OS, Tambs K, Rognerud M: **Measuring the mental health status of the Norwegian population: a comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36).** *Nord J Psychiatry* 2003, **57**:113–118.
23. Statistics Norway. [http://statbank.ssb.no/statistikkbanken/Default\\_FR.asp?PXSid=0&nvl=true&PLanguage=0&tildside=selectvarval/define.asp&Tabellid=07790](http://statbank.ssb.no/statistikkbanken/Default_FR.asp?PXSid=0&nvl=true&PLanguage=0&tildside=selectvarval/define.asp&Tabellid=07790).
24. Vickers AJ, Altman DG: **Analysing controlled trials with baseline and follow up measurements.** *BMJ* 2001, **323**:1123–1124.
25. Cameron ID, Schaafsma FG, Wilson S, Baker W, Buckley S: **Outcomes of rehabilitation in older people—functioning and cognition are the most important predictors: an inception cohort study.** *J Rehabil Med* 2012, **44**(1):24–30.
26. Poynter L, Kwan J, Sayer AA, Vassallo M: **Does cognitive impairment affect rehabilitation outcome?** *J Am Geriatr Soc* 2011, **59**(11):2108–2111.
27. Statistics Norway. <http://www.ssb.no/00/01/20/valgaktuelt/arkiv/art-2007-08-28-01.html>.
28. Statistics Norway. [www.ssb.no](http://www.ssb.no), [dra@ssb.no](mailto:dra@ssb.no).
29. Garåsen H, Windspoll R, Johnsen R: **Long-term patients' outcome after intermediate care at a community hospital for elderly patients: 12 months follow-up of a randomized controlled trial.** *Scan J Public Health* 2008, **36**(2):197–204.
30. Baztán JJ, Gálvez CP, Socorro A: **Recovery of functional impairment after acute illness and mortality: One-year follow-Up study.** *Gerontology* 2009, **55**:269–274.
31. Statistics Norway. [http://statbank.ssb.no/statistikkbanken/Default\\_FR.asp?PXSid=0&nvl=true&PLanguage=0&tildside=selectvarval/define.asp&Tabellid=05375](http://statbank.ssb.no/statistikkbanken/Default_FR.asp?PXSid=0&nvl=true&PLanguage=0&tildside=selectvarval/define.asp&Tabellid=05375).
32. Claesson L, Svensson E: **Measures of order consistency between paired ordinal data: application to the functional independence measure and sunnaas index of ADL.** *J Rehabil Med* 2001, **33**:137–144.
33. Beswick AD, Rees K, Dieppe P, Ayis S, Gooberman-Hill R, Horwood J, et al: **Complex interventions to improve physical function and maintain independent living in elderly people: a systematic review and meta-analysis.** *Lancet* 2008, **371**(9614):725–735.
34. Young J, Green J, Forster A, Small N, Lowson K, Bogle S, George J, Heseltine D, Jayasuriya T, Rowe J: **Postacute care for older people in community hospitals: a multicenter randomized, controlled trial.** *J Am Geriatr Soc* 2007, **55**(12):1995–2002.
35. Fjaertoft H, Rohweder G, Indredavik B: **Stroke unit care combined with early supported discharge improves 5-year outcome: a randomized controlled trial.** *Stroke* 2011, **42**(6):1707–1711.
36. Chen LK, Chen YM, Hwang SJ, Peng LN, Lin MH, Lee WJ, et al: **Effectiveness of community hospital-based post-acute care on functional recovery and 12-month mortality in older patients: a prospective cohort study.** *Ann Med* 2010, **42**(8):630–636.
37. Handoll HH, Cameron ID, Mak JC, Finnegan TP: **Multidisciplinary rehabilitation for older people with hip fractures.** *Cochrane Database Syst Rev* 2009, (4):CD007125. doi:10.1002/14651858.CD007125.pub2.
38. Stott D, Handoll H: **Rehabilitation of older people after hip (proximal femoral) fracture.** *Cochrane Database Syst Rev* 2011, (8):ED000023. doi:10.1002/14651858.ED000023.
39. Aaraas I, Sorasdekkkan H, Kristiansen IS: **Are general practitioner hospitals cost-saving? evidence from a rural area of Norway.** *Fam Pract* 1997, **14**(5):397–402.
40. Hakaart-van Roijen L, van Charante EP M, Bindels PJ, et al: **A cost study of a general practitioner hospital in the Netherlands.** *Eur J Gen Pract* 2004, **10**:45–49.
41. Kramer AM, Steiner JF, Schlenker RE, Eilertsen TB, Hrinkevich CA, Tropea DA, et al: **Outcomes and costs after hip fracture and stroke. a comparison of rehabilitation settings.** *JAMA* 1997, **277**(5):396–404.

doi:10.1186/1472-6963-12-400

**Cite this article as:** Johansen et al.: Independence, institutionalization, death and treatment costs 18 months after rehabilitation of older people in two different primary health care settings. *BMC Health Services Research* 2012 **12**:400.

**Submit your next manuscript to BioMed Central and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at  
[www.biomedcentral.com/submit](http://www.biomedcentral.com/submit)

